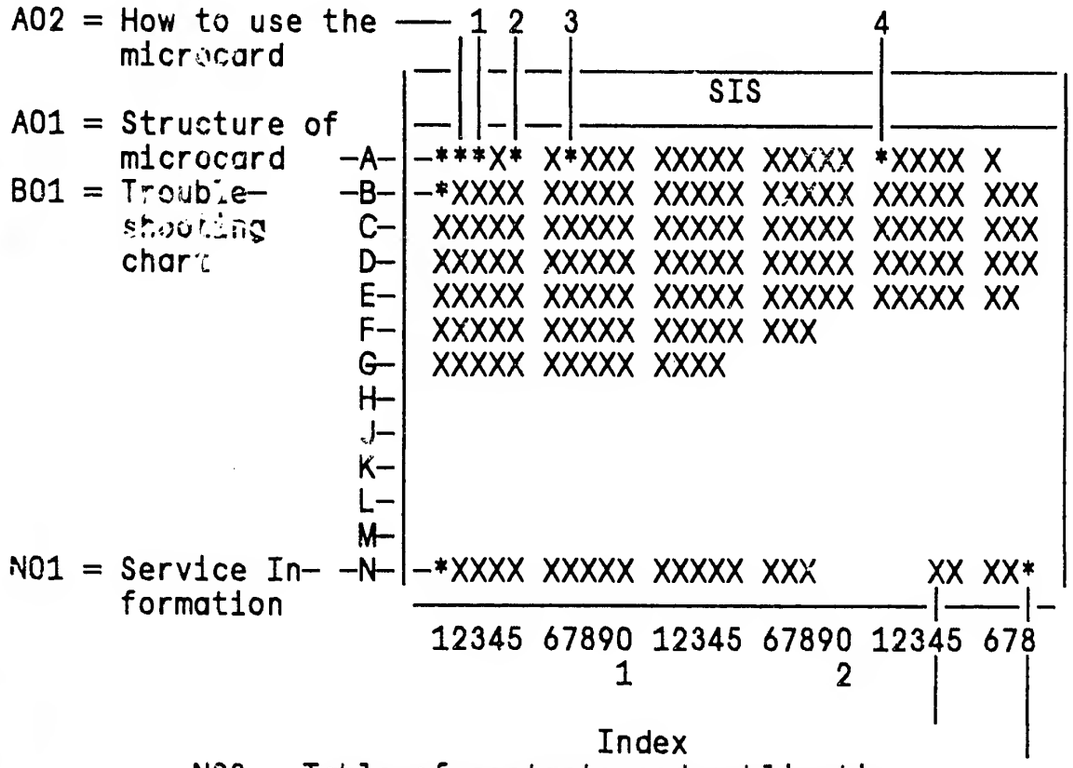
STRUCTURE OF THE MICROCARD (BASIC INSTRUCTIONS)

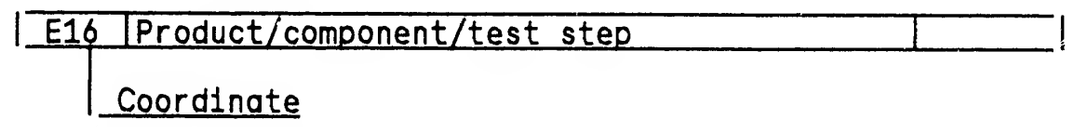


N28 = Table of contents and publication information

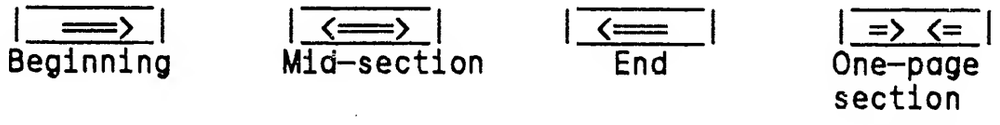
1 = Special features
2 = Safety and precautionary measures
3 = Test equipment and tools
4 = Installation position of components

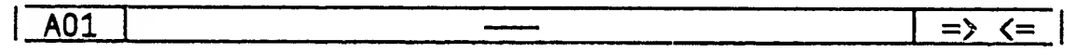
a. Read from left to right.

b. Title of micropicture (appears on each coordinate).



c. Limits of section





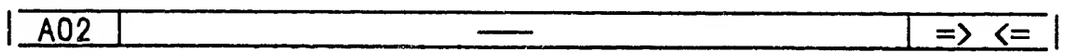
SPECIAL FEATURES

This microcard contains the trouble-shooting instructions for the following models, valid at the time of compilation:

* OPEL ASCONA C (1.1987)

ABS with 4 wheel-speed sensors and 4 hydraulic channels.

Test with the ABS2 LED Tester.



TEST SPECIFICATIONS

For reasons of safety, the ABS must be tested only with the ABS tester. The rapid diagnois chart contains all the important test specifications together with instructions for testing and trouble-shooting.

TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

* Regulatory tire size fitted?

* Check for firm seating and corrosion of ground of return-supply pump and of over-voltage protection relay term. 31.

* Check for leaks in hydraulic connections and sealing points at hydraulic modulator (visual examination).

* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on consuming devices) and goes out again by itself, check the battery and power supply (generator, regulator and voltage drops).

* If the ABS warning lamp lights up constantly and does not go out, check the following points:

- Controller plug sitting correctly on controller and latched?

- All plug contacts O.K.?

- Spring contacts latched?

- V-belt snapped?
(Generator provides no voltage, charge-indicator lamp and ABS warning lamp light up.

* For checking, switch on ignition to all program-selector-switch positions (tester operates with current supply from vehicle battery).

* Observe LED (green) for current supply in all program-selector-switch positions.

* Connect ABS2 LED tester to ABS wiring harness.

C A U T I O N !

Disconnect and connect controller only with ignition switched off.

Do not run with tester connected!

Repeat the complete test program after each repair.

The Antiskid System is a vehicle safety system.

Work on this system demands detailed knowledge of the system.

The conventional brake system must be O.K.

General information for trouble-shooting:

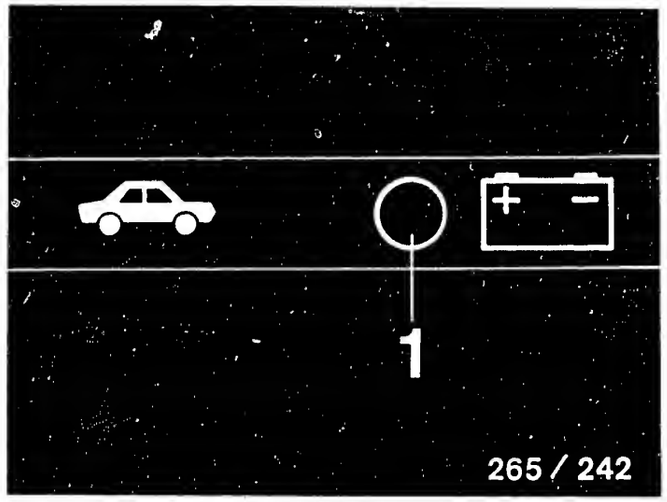
Check all leads for short circuit to ground and contact with positive lines and watch out for rubbed and pinched locations.

RAPID–DIAGNOSIS CHART FOR ABS2 LED TESTER

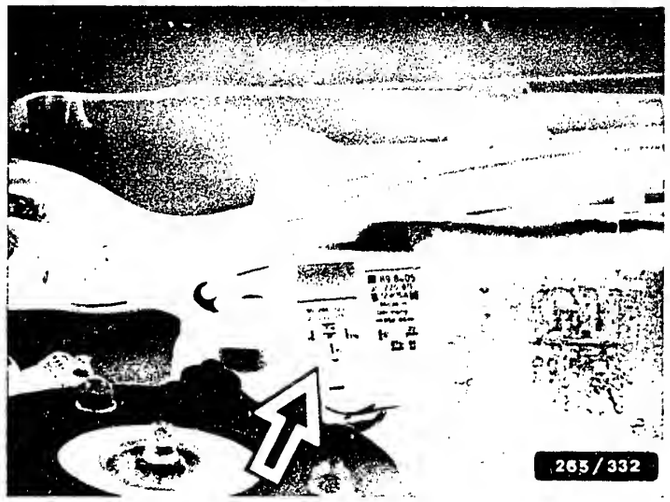
Do not drive vehicle with tester connected!

Program–switch position 1 to 6

Testing of (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of fault (see coordinate)
Voltage supply (term. 1 and term. 20)	Ignition on	LED 1 (top picture) lights up constantly	* 4–pin plug–in connection def. (C01) * Battery inadequately charged (C03) * Voltage drops too high (C03) * Overvoltage–protection rel. def. (C03) * Check lead to driving switch term. 15.



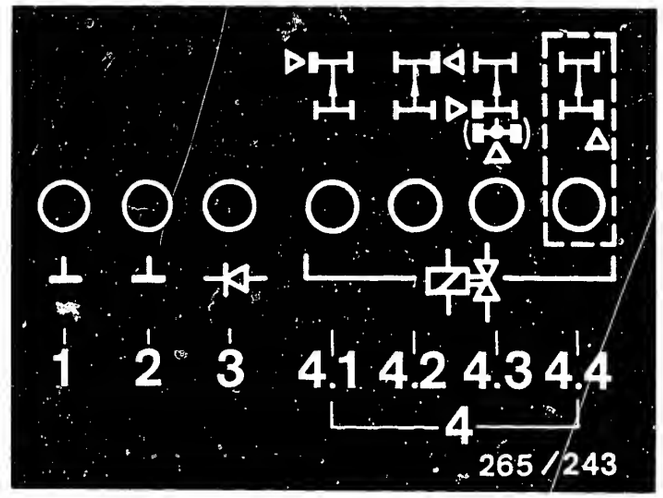
Arrow = Over–voltage protection relay



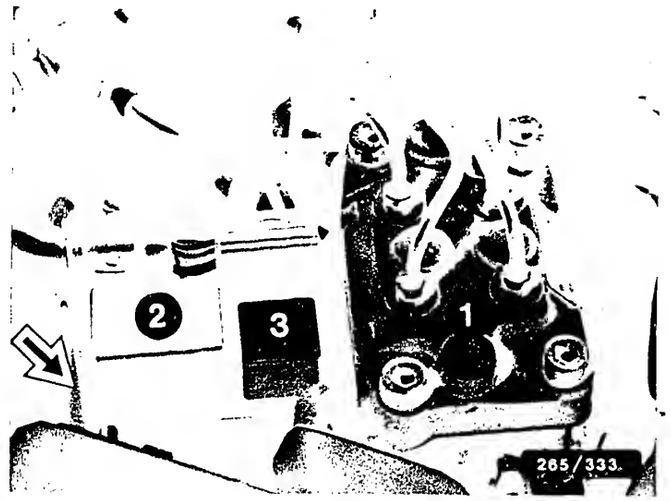
Rapid diagnosis chart (Continued 1)

Program-selector-switch position 1 (4-duct hydraulic modulator)

Test on (measurement at terminals)	Addit-ional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Ground (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal resistances (term.2, term.18, term.19, term.35) Off-position and ground of valve relay ABS warning lamp	Ignition on	7 LEDs (1 to 4.3) light up equal-ly brightly (upper ill.) ABS warning lamp in vehicle must light up	* LED 1 and / or 2 (upper illustration) do not light up: Check ground terminals for short circuit. (C05) * LED 3 (upper illustration) does not light up: diode defective, check ground of valve relay. (C07) * One or more LED 4 do not light up: Check corresponding plug connection for solenoid-operated valve and leads. (C06) Solenoid-operated valve, internal resistance 0,7...1,7 Ω * All LED 4 and LED 3 do not light up: Check ground of valve relay, valve relay defective. (C09) * Weak lighting of a LED means contact resistance in corresponding current path. (C09) * ABS warning lamp does not light up: warning lamp defective. Note: all other 7 LEDs light up (B01)

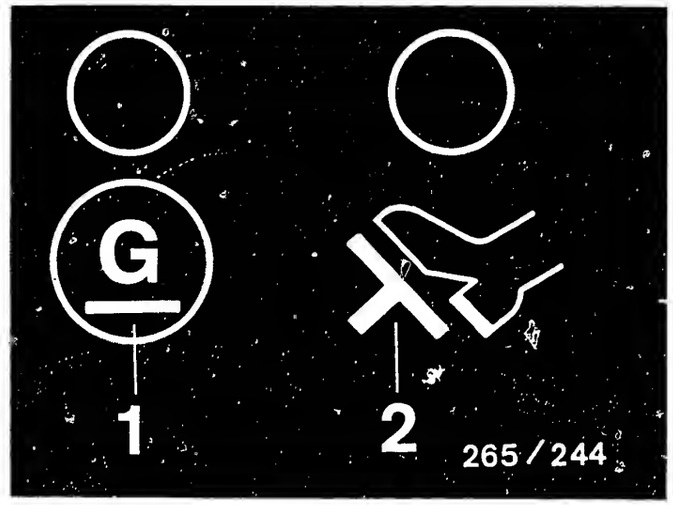


1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor



RAPID DIAGNOSIS CHART (CONTINUATION 2)

Program-selector-switch position 2

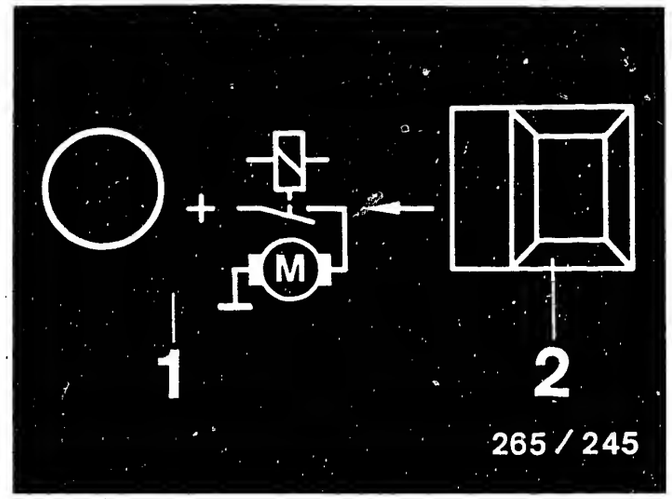


Test on (Measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Generator voltage of term. 61 term. 15)	Ignition on	LED 1 (upper illustration) lights up.	* LED sometimes goes out only after snap acceleration (test is then O.K.) (C17)
	Start engine	LED 1 (upper illustration) goes out with engine running	* Check lead to generator term. 61 * Generator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (upper illustration) lights up	* Stop-lamp switch defective. (C19) * Check lead to stop-lamp switch.
	Actuate brake pedal	LED 2 (upper illustration) goes out	* Lead at stop-lamp switch incorrectly connected.

Rapid diagnosis chart (Continued 3)

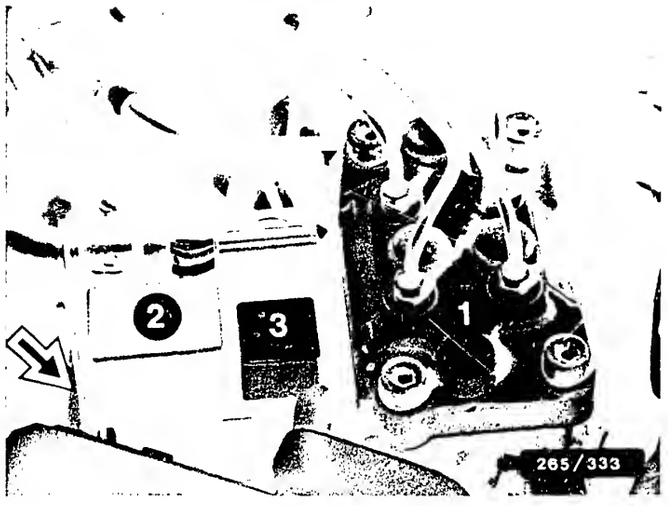
Program-selector-switch position 3

Test on (measurement at terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble (see coordinate)
Motor relay, pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, constantly press push-button 2 (upper illustration)	LED 1 lights up, pump motor runs. After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	* Motor relay defective (C21) * Check ground and positive terminal of hydraulic modulator (C23) * Check leads from controller term.14 and term.28 to hydraulic modulator term.9 or term.11. (C23) * Pump motor defective (C23)



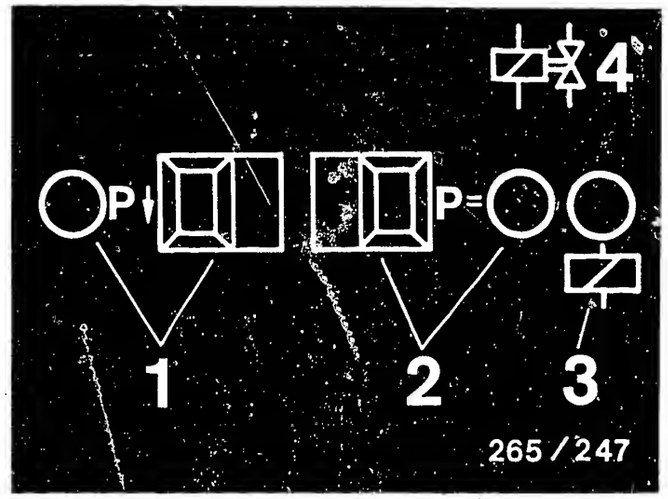
Program-selector-switch position 4 not applicable

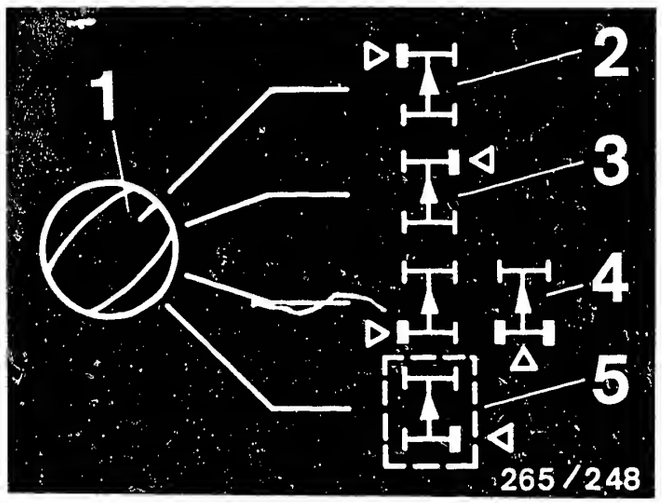
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor



RAPID DIAGNOSIS CHART (CONTINUED 4)
Program-selector-switch position 5 (4-channel hydraulic modulator)

Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Valve relay op. (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective (D03)
Solenoid-operated valves in hydraulic mod. for function and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. (Lower ill.)		* Repeat test with engine running * Valve relay (make contact) defective (D03) * Brake in line from valve relay term.87 to B+ (D03) * Brake leads at hydraulic modulator mixed up (D07) * Current value not obtained (LED P arrow or P= goes out; upper illustration): Battery insufficiently charged. Repeat test with engine running. (D05)
Operation pressure holding	1. Constantly press push-btn P= (upper ill.)	LED P= (upper ill.) lights up	
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper ill.)	LED P= goes out (upper ill.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper ill.) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left:term.2 Wheel, front right:term.35 Wheel, rear left:term.18 Wheel, rear right:term.19 Rear axle:term.— (D07) * Hydraulic modulator defective (D09)
	5. Release push-button P arrow (upper ill.)	LED P arrow (upper ill.) goes out, wheel locks	
	6. Release brake pedal		

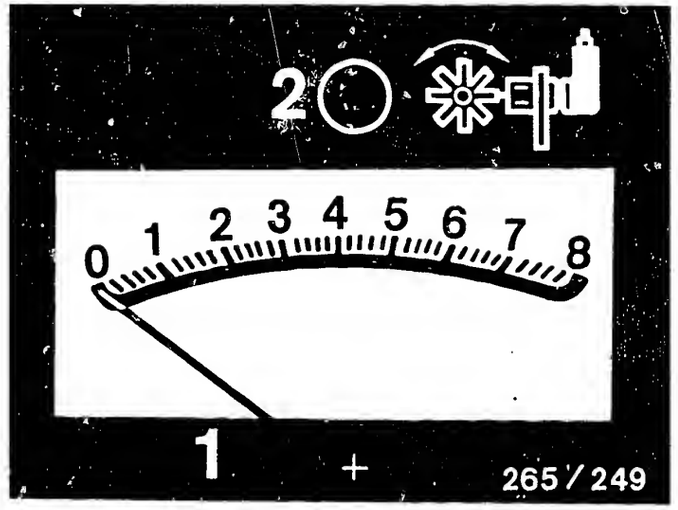


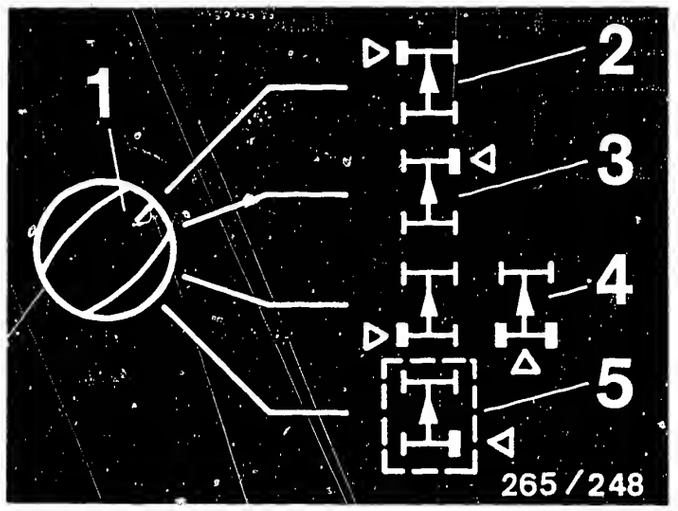


Rapid diagnosis chart (Continued 5)

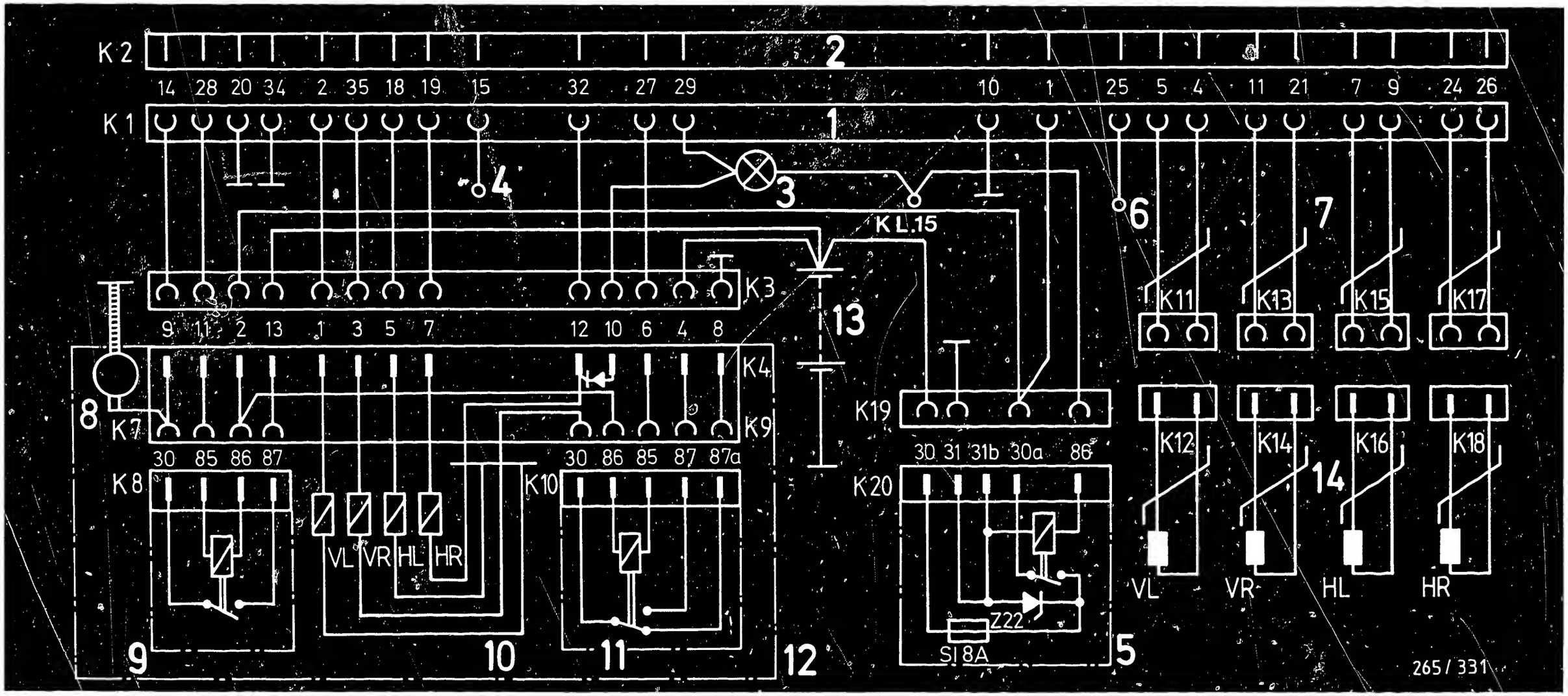
Program-selector-switch position 6 (4 wheel-speed sensor)

Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Wheel-speed sensor for operation and mix-up NOTE: Check each wheel separately in turn. (Wheel, front left: term.4 + term.5 Wheel, front right: term.11 + term.21 Wheel, rear left: term.7 + term.9 Wheel, rear right: term.24 + term.26	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked. Set switch for wheel selection to wheel to be tested (lower illustration) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 revolution per second). Afterwards read off reading at instrument: (upper illustration)	1. Smallest reading larger 1,6 divisions 2. Permissible fluctuation max. 25 % of greatest reading.	*Wheel-speed sensor lead mixed up (D15) *Break in wheel-speed sensor lead (D17) *Wheel-speed sensor defective (D17) Winding resistance front axle: 0,6...1,6 k Ω rear axle: 0,6...1,6 k Ω *Air gap between wheel-speed sensor and ring gear too wide (D19) *Ring gear defective or loose (D19) *Ring gear with incorrect number of teeth installed: Front axle: (48) teeth Rear axle: (48) teeth (D19) *Wheel-bearing clearance too large





Take for road test for final check. The warning lamp must go out when the engine is running. Drive at at least 30 km/h. The warning lamp must not light up again!



ELECTRICAL TERMINAL DIAGRAM

1 = Controller plug
2 = ABS controller
3 = ABS warning lamp
4 = To alternator D+
5 = Overvoltage-protection relay
6 = To stop-lamp switch (+)
7 = Multiple butt connector
8 = Return-pump motor
9 = Motor relay
10 = Solenoid valves
11 = Valve relay
12 = Hydraulic modulator
13 = Battery
14 = Wheel-speed sensor

VL = vl = Front left
VR = vr = Front right
HA = h = Rear axle
HL = hl = Rear left
HR = hr = Rear right
K1 to K18 = ABS plug-in connections

A17 — ⟹

A18 — ⟸

Designation	Code	Part number
ABS2 LED tester	KDAS 0003	Procure. address: Robert Bosch GmbH KH/VKD 3 Postfach 41 09 60 7500 Karlsruhe 41
Adapter lead (included in scope of delivery of tester)	KDAS 0003/2	
Charging and bleeding device		e.g. ATE Part No. 3.9302-1000.4 1)
Bleeder fitting for connection of charging and bleeding device to fluid reservoir of brake master cylinder		ATE Part No. 3.9302.0702.2 1)
Bleeder hose		ATE Part No. 3.3590.2300.1 1)
Auxiliary hose		ATE Part No. 3.9302.0704.2 1)
Brake-pedal-actuating device		ATE Part No. 3.9312.0100.4 1)

1) = obtainable from: Alfred Teves GmbH,
Guerickestr. 7
D-6000 Frankfurt (Main)

Designation	Code	Part number
Pressure tester Tester for checking low-pressure and high-pressure at hydraulic brake systems		e.g., ATE Part No. 3.9305-0200.4 1)
Flat double-end flare nut wrench, 9 x 11 mm		Hazet Part No. 612 2)
Container, approx. 1l for catching the brake fluid		
Brake fluid Use only DOT 4 or brake fluid from the vehicle manufacturer.		
Electrics tester or multimeter for trouble-shooting	ETE 014.00	0 684 101 400 commercially available

Aids!
Use only original brake lines from the vehicle manufacturer!

Grease for wheel-speed sensor	Molykote Longterm 2
Protective caps for brake lines	1 900 508 002 (100 pieces)
Protective caps for brake-line connections at hydraulic modulator	1 900 508 004 (100 pieces)

1) obtainable from: Alfred Teves GmbH Guerickestr. 7
D-6000 Frankfurt (Main)

2) obtainable from: Hazet Co, D-5630 Remscheid

For production reasons:
continued on the following coordinate.

INSTALLATION POSITION OF COMPONENTS

The installation positions given always refer to the forward direction of travel.

* ABS warning lamp:
  In the instrument panel, at the bottom left.

* Front-axle wheel-speed sensor:
  One on both left and right opposite the disk-brake caliper
  Plug-in connection for right-hand wheel-speed sensor beneath the overvoltage-protection relay
  Plug-in connection for the left-hand wheel-speed sensor beneath the washer-water container

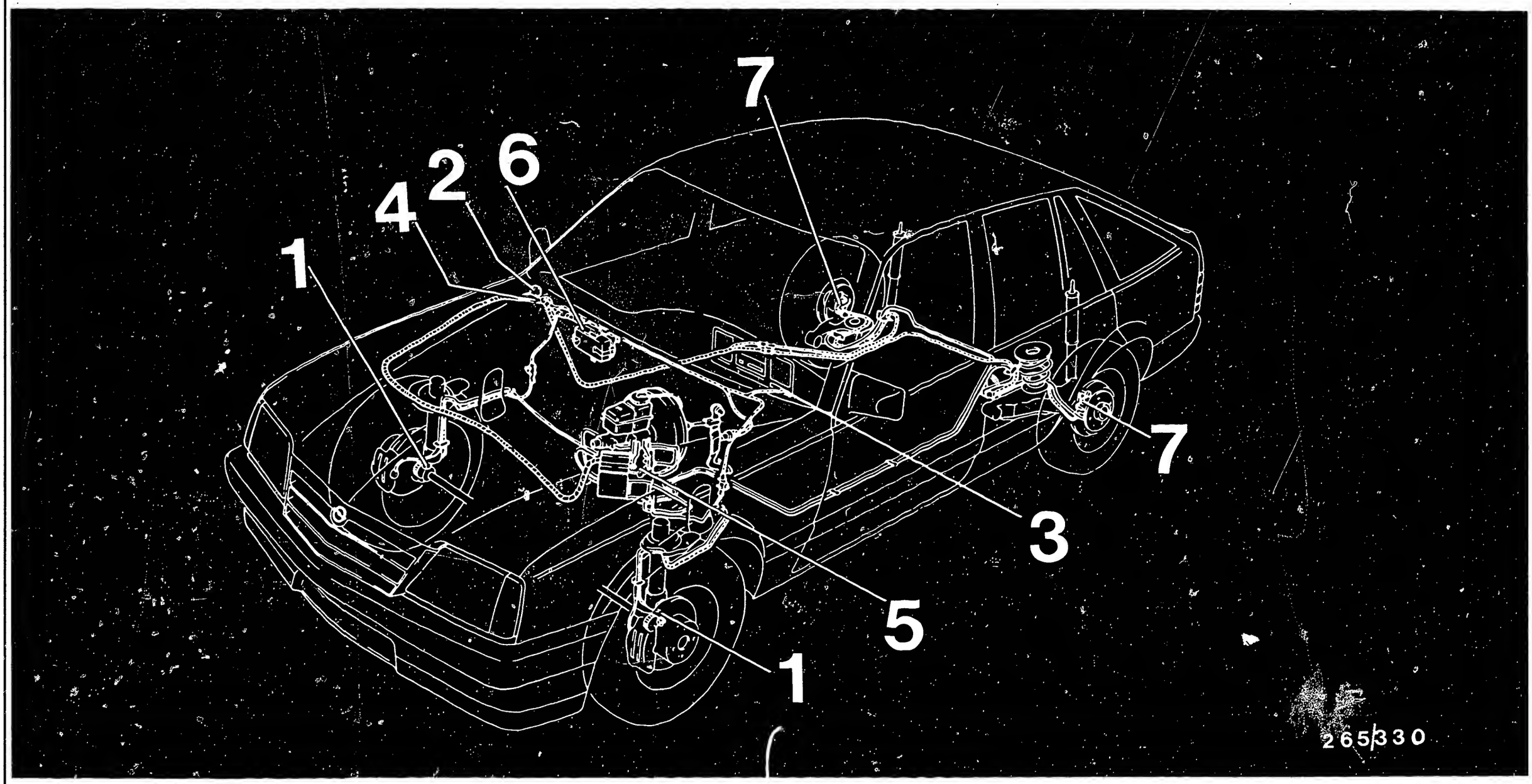
* Rear-axle wheel-speed sensor:
  One on both left and right on the inside alongside the brake drum
  Plug connections next to each other behind the reinforcement plate for the vehicle jack on the rear right in front of the rear wheel

* Hydraulic modulator:
  In the engine compartment on the left, beneath the master brake cylinder

* Controller:
  In the driver's footwell behind the glove box

* Overvoltage-protection relay:
  In the engine compartment on the right of the firewall

* Ground terminal:
  Ground terminal for ABS in the vicinity of the left-hand headlamp and at the hydraulic modulator



INSTALLATION POSITION OF COMPONENTS (CONTINUED)

1 = Wheel-speed sensor, front axle
2 = Overvoltage-protection relay
3 = ABS warning lamp
4 = ABS wiring harness
(integrated with Motronic wiring harness)
5 = Hydraulic modulator
6 = ABS controller
7 = Rotational-speed sensor, rear axle

LEAKAGE TEST FOR THE BRAKE SYSTEM

After replacing the hydraulic modulator, bleed the brake system and carry out a high-pressure test.

High-pressure test:

Line test pressure
Gauge pressure: approx. 70...90 bar

Test duration: approx. 10 minutes

Pressure drop of
set value: 0 %

Note:

The leakage test must be conducted for both brake circuits.

GENERAL INFORMATION FOR REPAIRS AND ON BRAKE SYSTEM

The ABS is basically maintenance-free, however, when working on vehicles with ABS system the following must be noted:

1. When welding with electric welding equipment, pull plug from electronic controller.

2. When painting, the electronic controller may be loaded for a short time to max. + 95°C and for a long time (approx. 2 hours) to max. + 85°C.

3. After exchange of hydraulic modulator, controller, wheel-speed sensor and of the wiring harness, as well as after work in which the ABS units are touched (e.g. accident repairs), check the complete ABS system with the tester.
   Pay attention to correct assignment of brake lines and wheel-speed sensor connections at controller as well as wheel-speed-sensor plug connections (see vehicle-specific terminal diagram).

4. Each time after working on the brake system, the latter must be bled and go through low-pressure and high-pressure tests. Check all connections for leaks.

5. Tighten battery terminals to terminal posts of battery.

6. Do not use a fast charger for starting the engine.

7. Never disconnect the battery from the vehicle electrical system when the engine is running.

8. When fast charging, disconnect the battery from the vehicle electrical system.

9. Take care that all connectors of the wiring harness are seated perfectly.

10. Never disconnect or connect the ABS wiring-harness plug from the controller when the ignition is switched on.

11. <u>For reasons of safety, the hydraulic modulator must never be repaired, but be exchanged only as a complete unit.</u>

    Excepted from this are the motor relay and the valve relay.
    Both relays may be exchanged.
    Apart from the brake-line connections, <u>no screws at the hydraulic modulator may be loosened.</u>
    Once they are loosened, it is impossible to make the brake circuits leak-free ever again!

<u>There is d a n g e r t o l i f e !</u>

<u>Caution when handling brake fluid!</u>

a) Fill brake fluid only into containers from which no one would mistakenly drink the fluid. <u>(D a n g e r - p o i s o n o u s !)</u>

b) Even slight traces of mineral oil leads to failure of the brake system. Take particular care with respect to colorless through to yellow-dyed brake fluid, since the danger of a mix-up is in this case greatest.
If mineral oil is found in the brake system or there is suspicion of this being the case, thoroughly flush out the complete brake system with brake fluid. In addition, replace the main cylinder.

c) Do not allow brake fluid to come into contact with the vehicle paintwork, since the fluid contains elements which act as solvents for paint.

d) Brake fluid is highly hygroscopic, i.e. it absorbs moisture from the air, which lowers its boiling point. For this reason, store brake fluid only in well-sealed storage containers.

<u>Note:</u>

During the course of the service life of brake fluid, its boiling point drops through continuous absorption of moisture from the atmosphere.
In the case of very high loading of the brakes, vapor bubbles may therefore develop in the brake system.
<u>Therefore, replace the brake fluid once a year,</u> preferably in Spring.

OPERATION AND TESTING OF THE ABS WARNING LAMP

A vehicle equipped with ABS comes into the workshop with one of the following customer complaints:

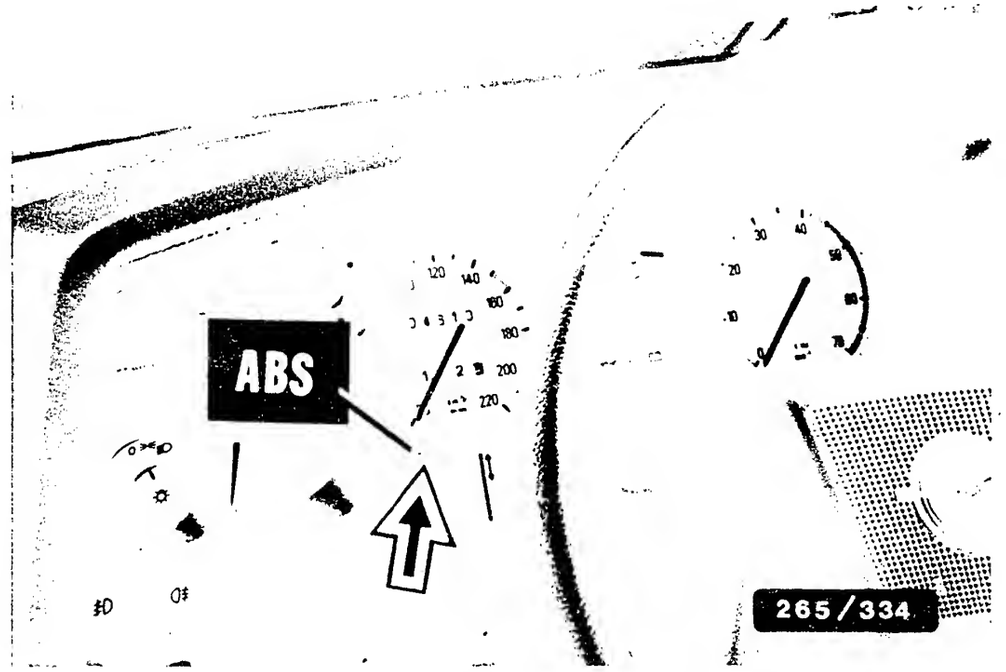
* Warning lamp does not light up after swtching on ignition.
* Warning lamp does n o t go out after reaching idle speed.
* Warning lamp lights up again while driving or lights up occasionally.

Make sure of the circumstances before checking the complete ABS system with the ABS tester.

For reasons of safety, testing of the ABS is permitted only with the ABS tester.

When connecting the ABS tester, just as when disconnecting and connecting the controller, the ignition must always be switched off.

The following gives information about the functioning and malfunctioning of the ABS warning lamp.



ABS = ABS warning lamp in instrument panel

ABS warning lamp

When the ignition is switched on, the warning lamp, marked with the letters "ABS", lights up.
When the engine starts and reaches idle speed the ABS warning lamp goes out (terminal 61 of generator supplies voltage to ABS controller).
As soon as all 4 wheels of the vehicle exceed a speed of approx. 6 km/h for the first time after starting, the ABS system tests itself automatically (BITE sequence).
This procedure is repeated every time the ignition is switched off and the engine started up again. In addition, the ABS constantly tests itself to a certain extent while the vehicle is travelling.

Incorrect warning-lamp indications are:

* Warning lamp does not light up after swtching on ignition.

* Warning lamp does not go out after reaching idle speed.

* Warning lamp lights up when driving or lights up occasionally.

Lighting-up of the ABS warning lamp indicates to the driver that the ABS is defective.

Nevertheless, braking can still take place with the conventional brake system.

However, it is possible for the wheels to lock.

General information:

Occasional lighting up of the warning lamp may be brought about through the battery being insufficiently charged.

The lamp lights up only as long as there is under-voltage, e.g. after switching on consuming devices when at idle.

The causes of trouble can be determined with the assistance of the ABS tester.

OPERATION OF THE ABS2 LED TESTER

1. General

The BOSCH ABS2 LED TESTER checks the ABS components in a passenger car with hydraulic brake system.
The following BOSCH ABS systems can be checked:

* All ABS 2 versions (at present, ABS 2, ABS 2 B)
* ABS 2 B-function of the electronic traction control (ETC)

The tester checks the peripheral system components in 6 program steps:

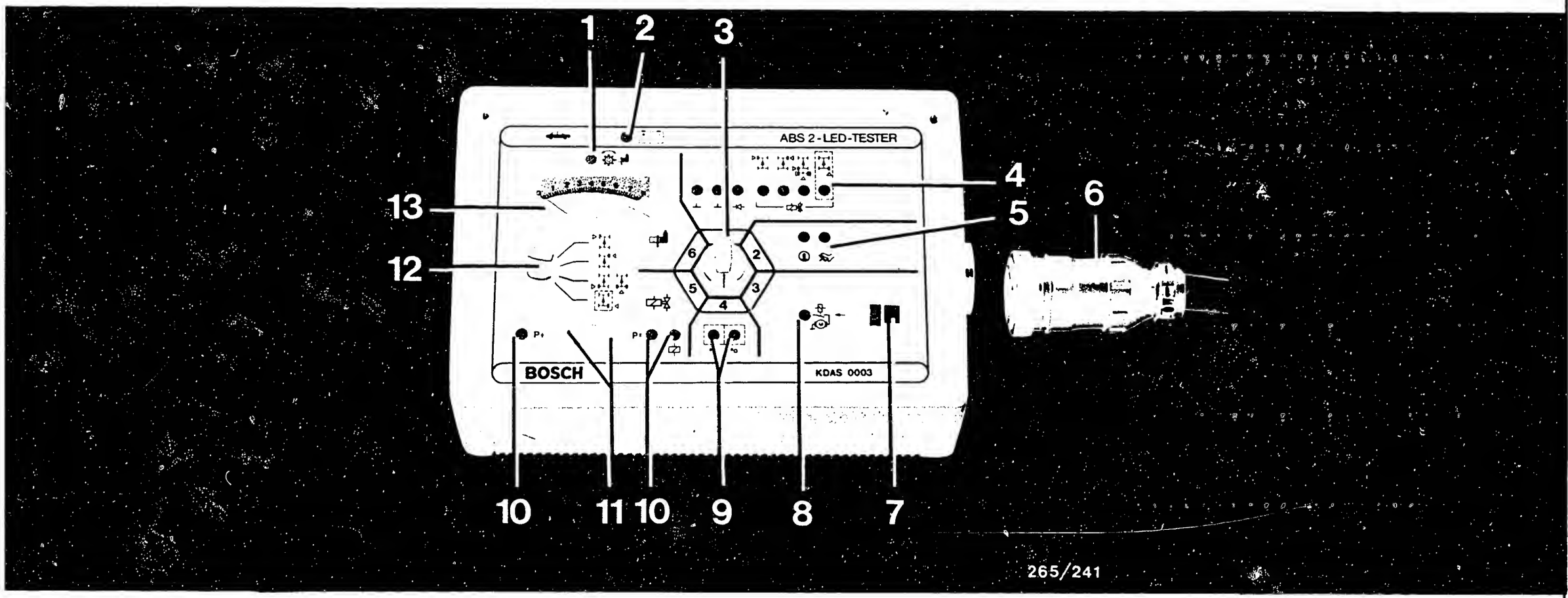
* Hydraulic modulator
* Motor relay
* Valve relay
* Wheel-speed sensors
* Warning lamp
* Acceleration sensor
* Wiring harness
* Plug connections
* Ground cables
* Stop-lamp switch signal
* Generator signal

The ABS controller is not tested.

Self-diagnosis within the ABS controller makes additional testing of the controller with the tester unnecessary.

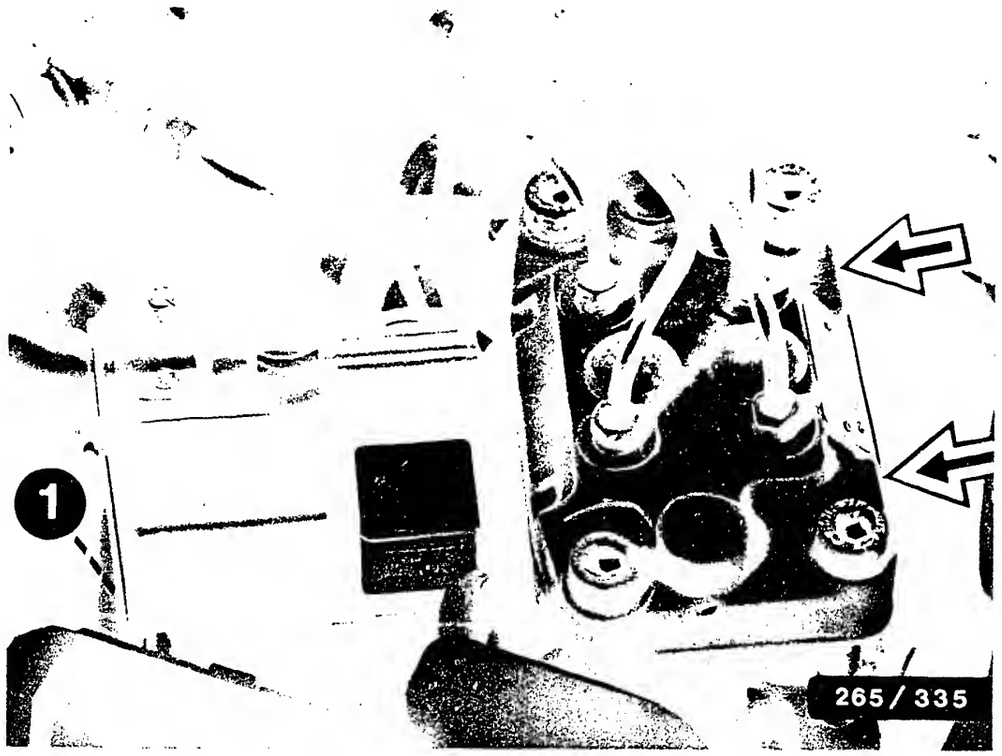
A brake test bench is not required for testing the ABS.
If a brake test bench is used, there is a danger of the vehicle jumping off the rollers!
Responsibility lies with the testing personnel if a brake test bench is used.

2. Structure of tester
Failure is indicated by light-emitting diodes (LEDs), with the exception of wheel-speed sensor signals which are read off at the indicating instrument.



1 = 1 LED indicator for wheel speed in program-selector-switch position 6
2 = 1 LED indicator for battery voltage
3 = Program switch
4 = 7 LED indicators for program-selector-switch position 1
5 = 2 LED indicators for program-selector-switch position 2
6 = ABS adapter lead for connection to ABS wiring harness in vehicle
7 = Push-button for motor-relay control in program-selector-switch position 3
8 = 1 LED indicator for program-selector-switch position 3
9 = 2 LED indicators for program-selector-switch position 4
10 = 3 LED indicators for program-selector-switch position 5
11 = 2 push-buttons for tripping solenoid-operated valve functions.
Pressure-holding and pressure-release in program-selector-switch position 5
12 = Rotary switch for selection of individual wheels.
Functional in program-selector-switch position 5 and 6
13 = Indicating instrument for program-selector-switch position 6

Structure of tester (Continued)



1 = Ground connection of return pump
Arrow = Sealing points

TEST CONDITIONS FOR TESTING WITH
ABS2 LED TESTER

* Specified size of tire fitted?

* Check that ground connection of return pump is connected securely.

* Check that ground strap between block and vehicle frame is connected securely.

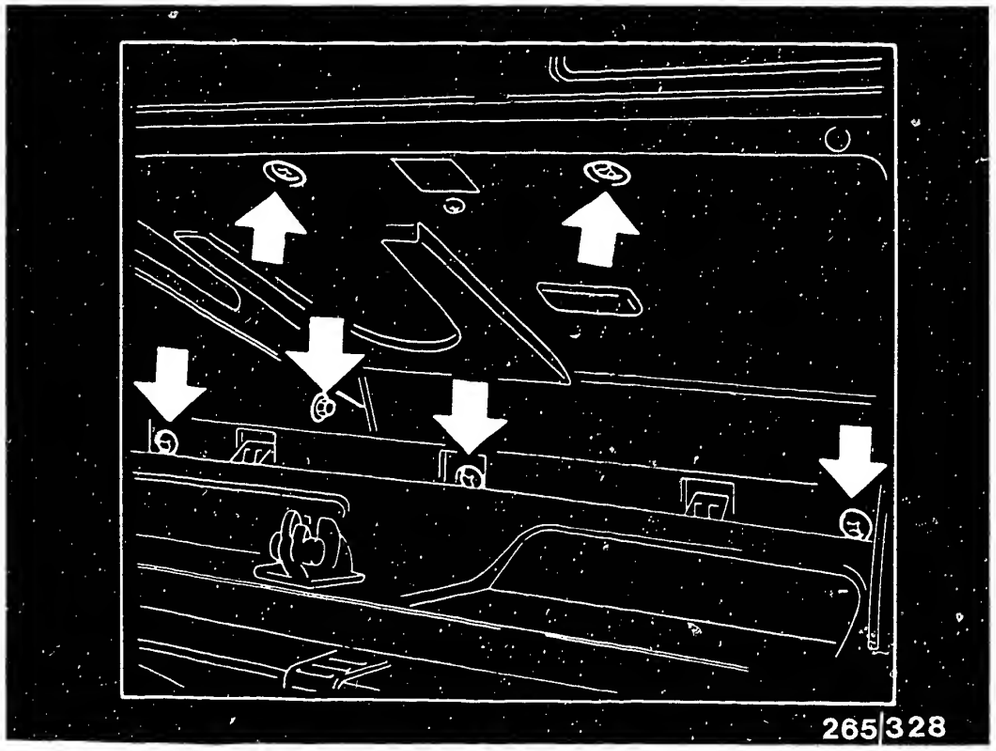
* Check hydraulic connections on hydraulic modulator and sealing points (arrows) for leakage (visual inspection).

* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on consuming devices) and goes out again by itself, check the battery and power supply (generator, regulator and voltage drops).

* If the ABS warning lamp lights up constantly and does not go out, check the following points:

-> Controller plug sitting correctly on controller and latched?
All plug contacts O.K.?
Spring contacts latched?

-> V-belt snapped? (Generator provides no voltage, charge-indicator lamp and ABS warning lamp light up).



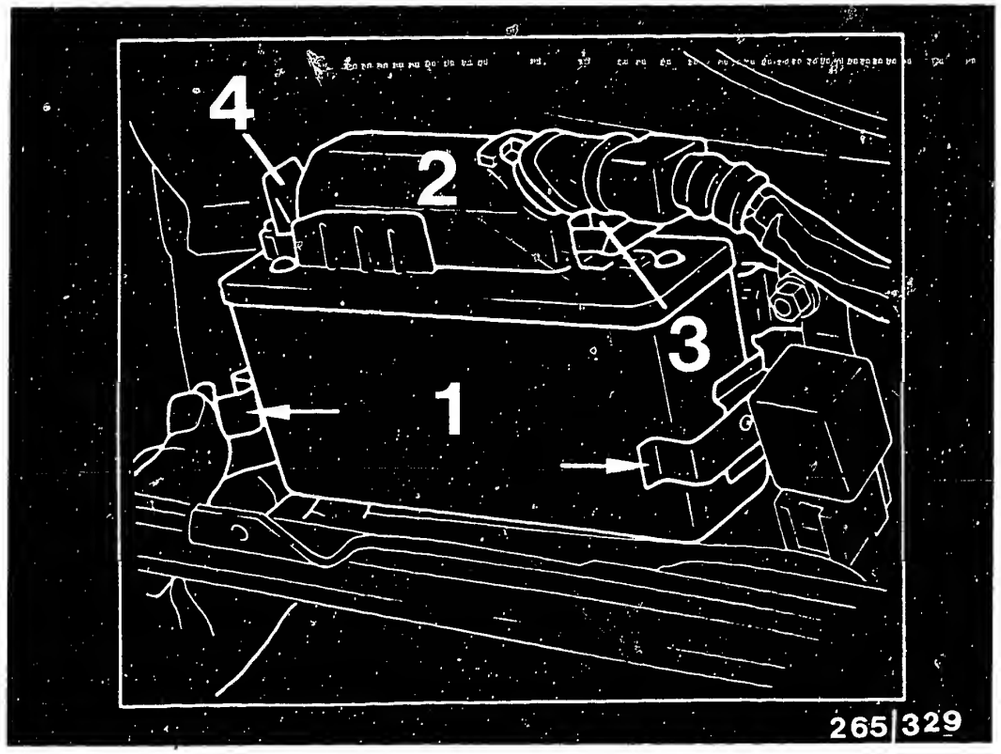
Arrows = Fastening screws

* Remove glove box

Loosen and remove fastening screws as shown in the illustration (arrows)

Pull out glove box and detach connections of glove-box lighting.

Controller is behind the glove box



1 = Controller for ABS
2 = Controller plug (35-pin)
3 = Spring
4 = Encoding unit
Arrows = Retaining clips

* Connect LED tester to ABS wiring harness.

Caution!
Make sure ignition is switched off when detaching and inserting controller.
To remove the controller, press the retaining clips outwards and pull out controller from holder
Force back spring, fold up controller plug and detach from encoding unit.

* For checking with tester, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).

* One LED (green) indicates whether the voltage is sufficient.

Caution!

Do not run with tester connected!

After each repair, repeat the complete test program.

General note for trouble-shooting

Check all leads for short circuit to ground and contact with positive leads and watch out for rubbed and pinched locations.

For production reasons:
continued on the following coordinate.

TEST CHART FOR ABS 2 LED TESTER

TEST STEP 1 (TEST SPECIFICATIONS AND NOTES ON OPERATION)

Component/Operation

Voltage supply (term. 20 and term. 1)

* Operation: Position:

Program switch	all
Push-button	–

* Operation in vehicle:
Ignition on.

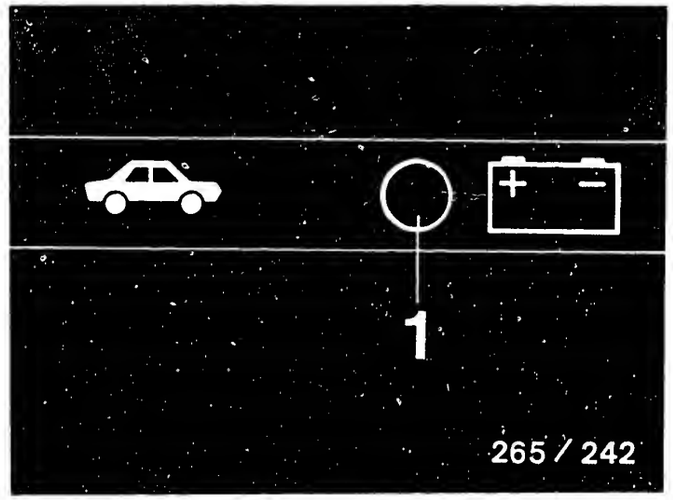
* Test specification (indication)
LED 1 (upper illustration) lights up continuously in all program-selector-switch positions.

N>

Trouble-shooting:

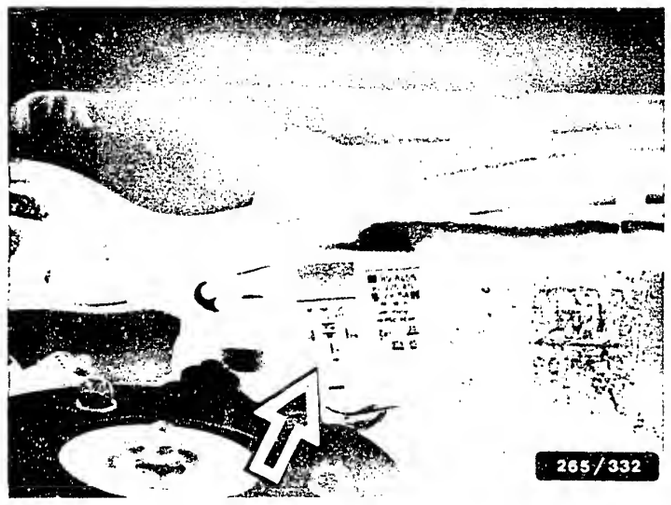
Switch off ignition!

No indication:
* Controller plug incorrectly connected
* Over-voltage protection relay defective: exchange.



1 = LED for supply voltage

Arrow = Over-voltage protection relay



Continued C05

Continued on next coordinate

C01 ⟹

C02 ⟺

Check the following cables:

* Positive cable from B+ to overvoltage-protection relay term. 30
* Negative cable from overvoltage-protection relay term. 31 to ground.
* ABS ground terminal must be bare metal and must have no contact resistance.
* Positive cable from overvoltage-protection relay term. 30a to controller plug K1/term. 1.
* Positive cable from overvoltage-protection relay term. 86 to driving switch term. 15.
* Check that ground strap between engine block and vehicle frame is attached firmly.

LED 1 (green) lights up occasionally during the course of the test:

Interrupt test and eliminate fault.

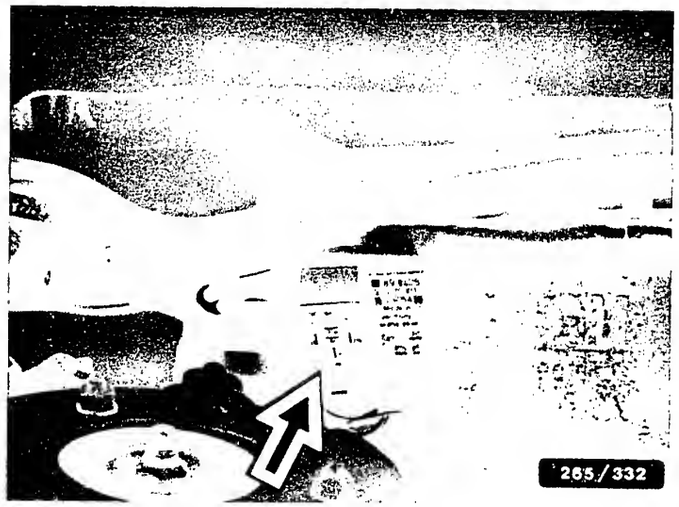
Fault causes:

1. Battery inadequately charged.
   Charge battery or keep engine running.
2. Too high voltage drops at ABS ground terminal; ground terminal must be bare metal.

After elimination of faults, perform complete test program.

Arrow = Ground terminal for ABS and Motronic

Arrow = Over-voltage protection relay



TEST STEP 2 (TEST SPECIFICATIONS AND NOTES ON OPERATION)

V

Component/Operation:

Ground (term.34, term.10)
Diode for warning lamp (term.29, term.32)
Solenoid-operated valve internal resistances (term. 2, term.35, term.18, term.19)
Off-position and ground of valve relay
ABS warning lamp.

* Operation:	Position:
Program switch	1
Push-button	–

* Operation in vehicle:
Ignition on.

* Test specification (indication)
LED 1 to LED 4.4
light up equally brightly (see upper illustration).

ABS warning lamp in vehicle must light up.

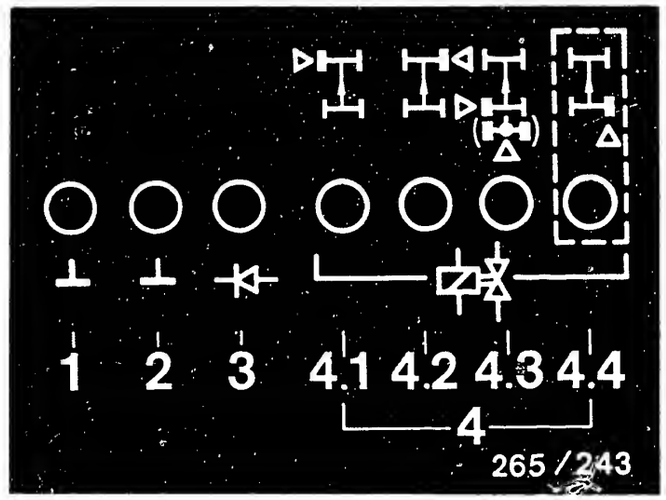
N>

Trouble-shooting:

Switch off ignition!

1. LED 1 and/or 2 (top picture) not lit up:

* Check ground terminal on left-hand headlamp and ground strap between engine block and vehicle frame for firm connection, too high contact resistance and open circuit.



Y

V

Continued C17

V

Continued on next coordinate

C05 —— <==>

C06 —— <==>

* Check cable from ground to controller plug K1/term. 10 for contact resistance and open circuit.

* Check cable from ground to controller plug K1/term. 34 for contact resistance and open circuit.

* Valve relay defective

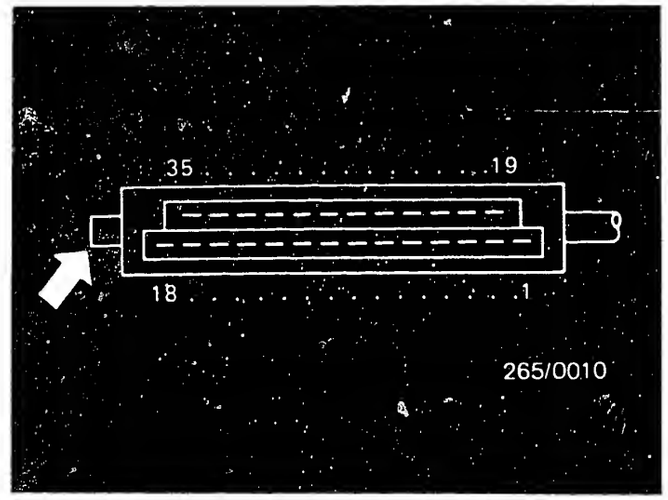
C a u t i o n !
Use relay with correct electrical terminal assignment only.

2. LED 3 does not light up:

* Check diode in forward and reverse direction with ohmmeter between K4/term. 10 and K4/term. 12.
If diode defective, replace hydraulic modulator.

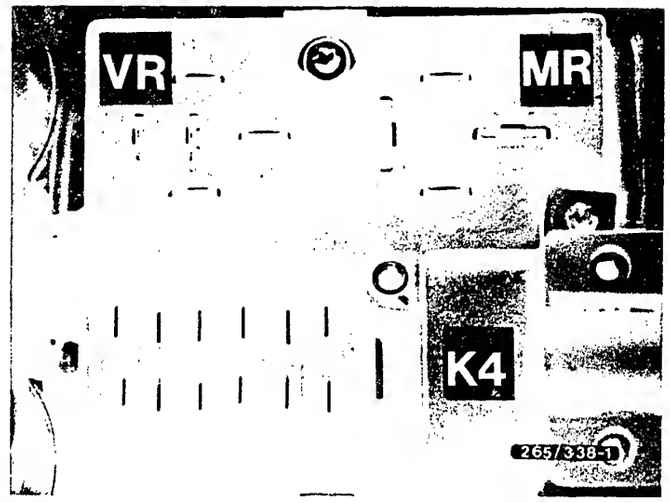
* Check ground connection of valve relay for contact resistance and open circuit:

From plug K3/term. 8 to ground.



Top view of controller plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding

Plug plate of hydraulic mod., position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug



One or several LED 4 do not light up:

* Measure internal resistance directly at hydraulic modulator.

  Test specifications:
  Valve VL (LED 4.1) between K4/term.1 and K4/term.12: 0,7...1,7 Ω
  Valve VR (LED 4.2) between K4/term.3 and K4/term.12: 0,7...1,7 Ω
  Valve HL (LED 4.3) between K4/term.5 and K4/term.12: 0,7...1,7 Ω
  Valve HR (LED 4.4) between K4/term.7 and K4/term.12: 0,7...1,7 Ω

* If test specification not obtained:
  Exchange hydraulic modulator.

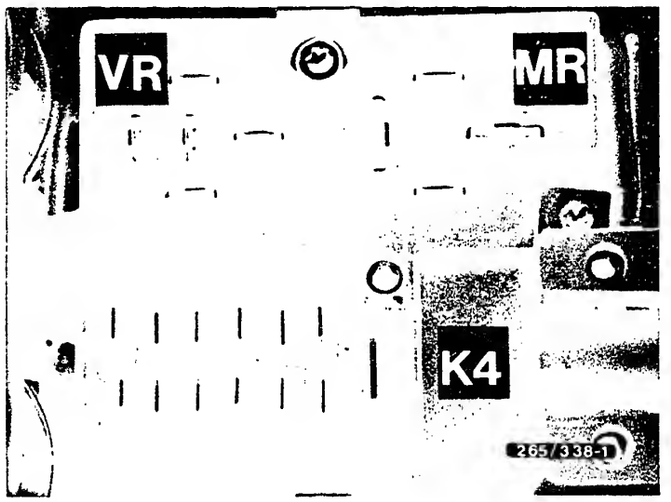
* Check leads for continuity (test specification: 0 Ω):
  Valve VL (LED 4.1) between K3/term.1
  and controller plug K1/term.2
  Valve VR (LED 4.2) between K3/term.3
  and controller plug K1/term.35
  Valve HL (LED 4.3) between K3/term.5
  and controller plug K1/term.18
  Valve HR (LED 4.4) between K3/term.7
  and controller plug K1/term.19

If test specification not obtained:
Check plug connection for short circuit, corrosion and mechanical defects. Eliminate interruption.

3. All LED 4 and LED 3 do not light up:
* Check for contact resistance and short circuit in ground of valve relay:
  From plug K3/term.8 to ground terminal.
* Valve relay defective.

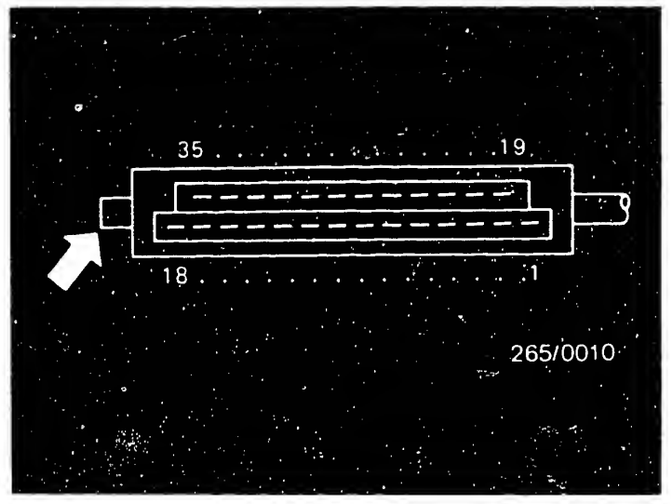
4. Weak lighting up of one LED:
* This means contact resistance in the corresponding current path.

5. ABS warning lamp does not light up:
  Warning lamp defective.
  Check lead to driving switch term.15 and controller term.29.
  Note:
  All 7 of the other LEDs must light up.



Plug plate of hydraulic mod., position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug

Top view of controller plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



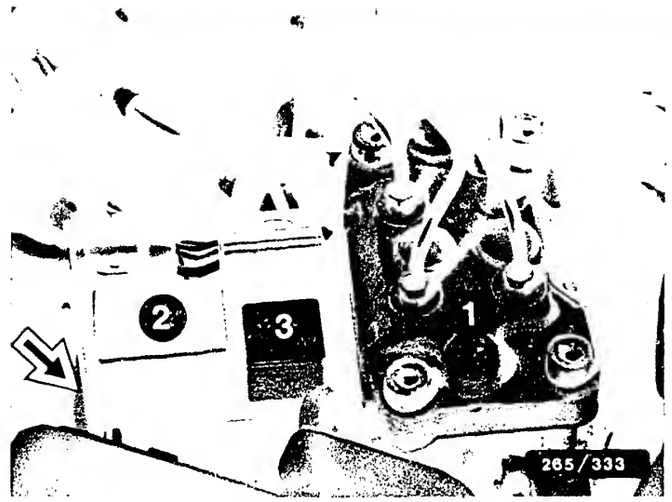
Removing the hydraulic modulator

* For reasons of safety, the hydraulic modulator must not be repaired, but replaced only as a complete unit.

  Excepted are the motor and valve relays.
  Both relays may be replaced.

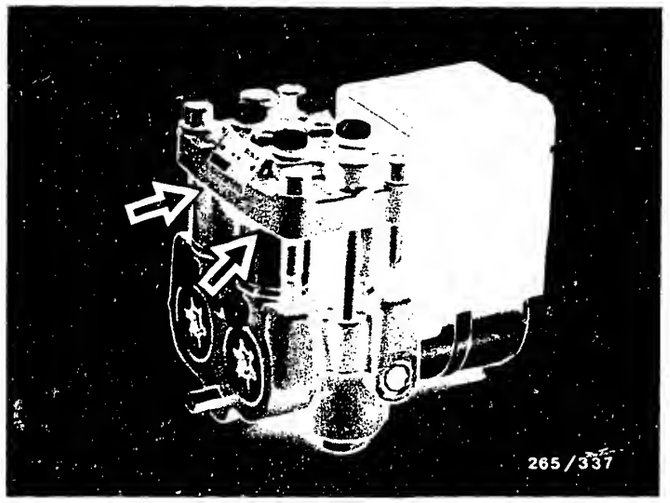
* Excepting brake-line connections, no screws on the hydraulic modulator may be loosened.
  In particular, the hexagon-socket-head cap screws or Torx screws must under no circumstances be loosened.
  After loosening, the brake circuits can never be sealed again.
  D a n g e r t o l i f e !

* Make visual examination for leaks in hydraulic modulator and brake-line connections.
  Pay particular attention to the sealing points indicated by arrows (upper illustration).
  If brake fluid is escaping, tighten (12...16 Nm) or replace the brake-line connections, or replace the hydraulic modulator.



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

Arrows = Sealing points

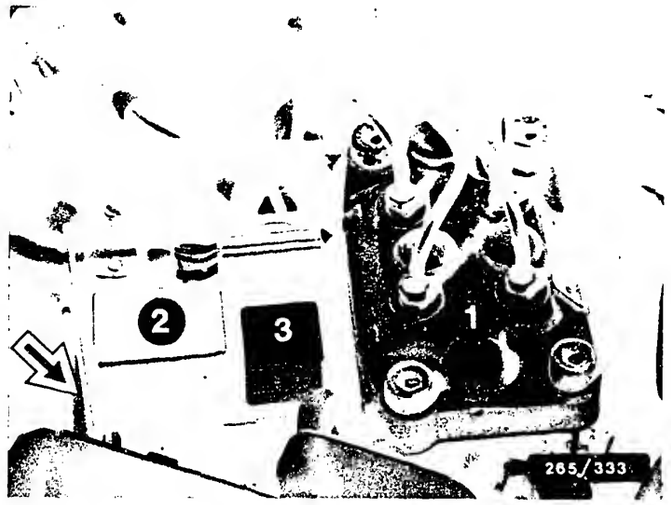


At the base of the hydraulic modulator there is a ventilation bore to the pump plunger.
It is possible that small amounts of brake fluid may escape at this point.
A complaint is justified only if a pool of brake fluid forms beneath the hydraulic modulator when the brake pedal is pressed several times.

* When removing and installing the brake lines, ensure that the lines are marked in accordance with the identification on the hydraulic modulator and are connected again in the appropriate way (e.g. "1" from the hydraulic modulator must be connected to the front left wheel brake cylinder).

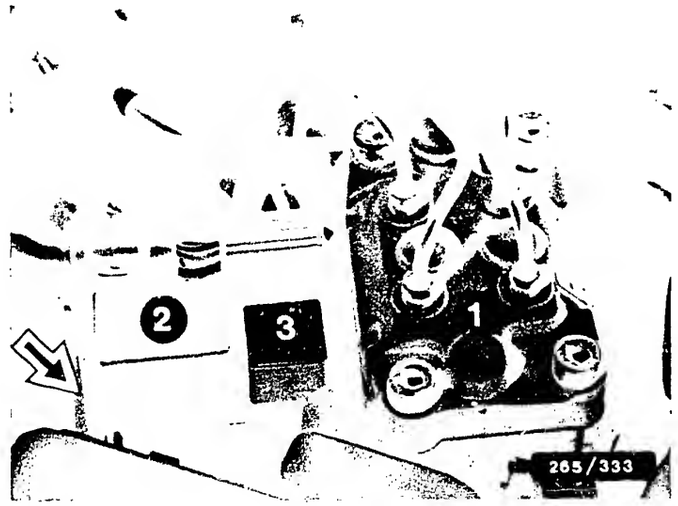
* Identification on hydraulic modulator:

VL = Connection for brake line front left (wheel brake cylinder)
VR = Connection for brake line front right (wheel brake cylinder)
HL = Connection for brake line rear left (wheel brake cylinder)
HR = Connection for brake line rear right (wheel brake cylinder)
V = Front-axle brake circuit from brake master cylinder
H = Rear-axle brake circuit from brake master cylinder



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

* Use only the specified double-head box wrench 9 x 11 mm for loosening and tightening the brake lines.
* Code brake lines and loosen from hydraulic modulator.
* Catch brake fluid and avoid contact with skin, clothing or paintwork!
* Seal brake lines and connections immediately with dummy plugs.
* Disconnect ground cable at pump motor.
* Loosen fastening screw and remove cap.
* Loosen hoop and remove plug.
* Loosen hexagon nuts of bracket and remove hydraulic modulator.



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

Installation

* Position hydraulic modulator into bracket and tighten with the hexagon nuts.
* Connect ground cable to pump motor. Connect 13-pin plug and fasten with the hoop.
* Tighten cap with screw on the hydraulic modulator.
* Connect brake lines to hydraulic modulator according to coding.
* Pay attention to tightening torque for brake-line connections at hydraulic modulator: 12...16 Nm.
* Bleed brake system and check for leaks.
* Thoroughly check ABS with tester.

TEST STEP 3 (TEST SPECIFICATIONS AND NOTES ON OPERATION)

Component/Operation:

Generator voltage of term. 61 (term. 15)

* Operation: Position:
  Program switch 2
  Push-button –

* Operation in vehicle:
  Ignition on.

* Test specification (indication):
  LED 1 (upper illustration) lights up.

* Operation in vehicle:
  Start engine.

* Test specification (indication)
  LED 1 (upper illustration) goes out when engine running.

N

Trouble-shooting:

LED 1 does not go out when engine running:

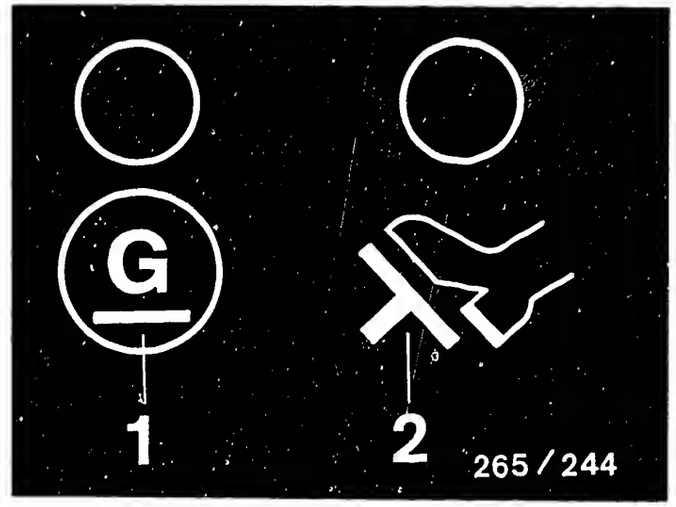
* Briefly accelerate.
  If LED 1 goes out, test is O.K.

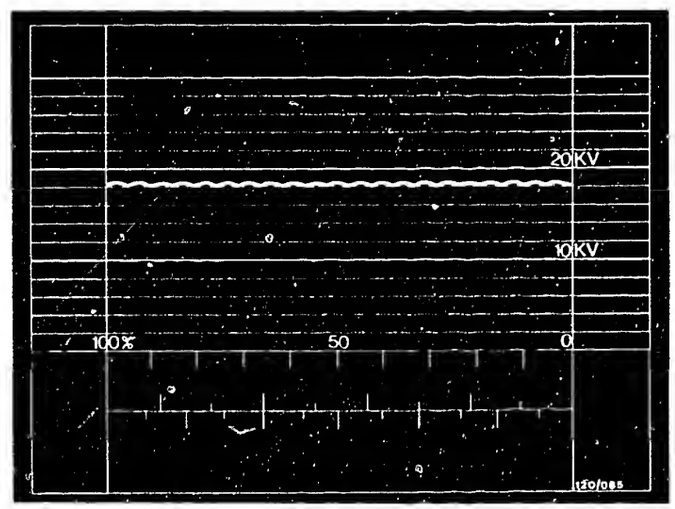
* Voltage measurement at K1/ term. 15 with engine running.
  Test specification: greater than 10 V.

* Oscilloscope measurement at K1/ term. 15 with engine running.

* Voltage smaller than 10 V or pattern indicating defects.

* Repair generator and/or lead.





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Continued on next coordinate

TEST STEP 3 (CONTINUED) (TEST SPECIFICATIONS AND OPERATING INSTRUCTIONS)

V

Component/Operation:

Stop-lamp switch term. 25.

* Operation: / Postion:
  Program switch — 2
  Push-button — –

* Operation in vehicle:
  Ignition on.

* Test specification (indication):
  LED 2 (upper illustration) lights up.

* Operation in vehicle:
  Actuate brake pedal.

* Test specification (indication)
  LED 2 (upper illustration) goes out.

N>

Trouble-shooting:

1. LED 2 does not light up:

* Stop lamps defective.
  High contact resistance of stop lamps or their ground.
  Break in lead from controller term. 25 to stop-lamp switch.

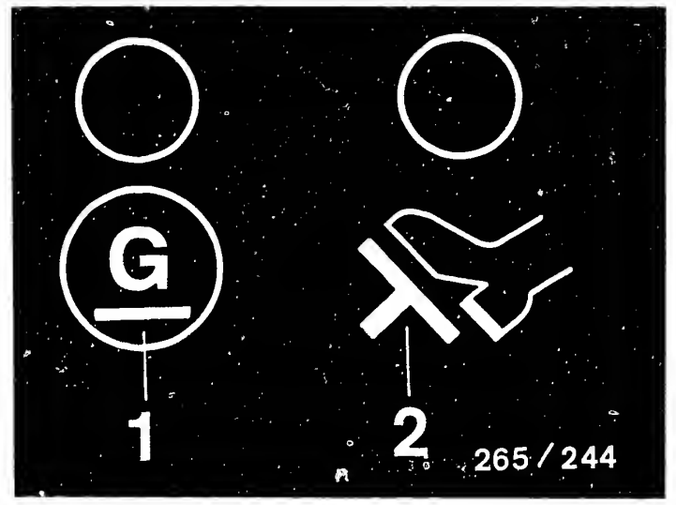
2. LED does not go out or only becomes somewhat dimmer:

* Fuse No. 7 for stop-lamp switch in fuse box defective.

* Voltage drop at stop-lamp switch (switch defective) or its plug connections.

* Stop-lamp switch defective.

* Lead to stop-lamp switch incorrectly connected.



Y

V

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TEST STEP 4 (TEST SPECIFICATIONS AND NOTES ON OPERATION)

V

Component/Operation:

Pump-motor motor relay in hydraulic modulator
(term.28, term.14).

* Operation: Position:

Program switch	3
Push-button (upper ill.)	2

* Operation in vehicle:
Ignition on.
Keep push-button 2 (upper ill.) pressed.

* Test specification (indication):
LED 1 lights up, pump motor runs.

After releasing the push-button, LED 1 stays lit due to run-on of motor (upper illustration).

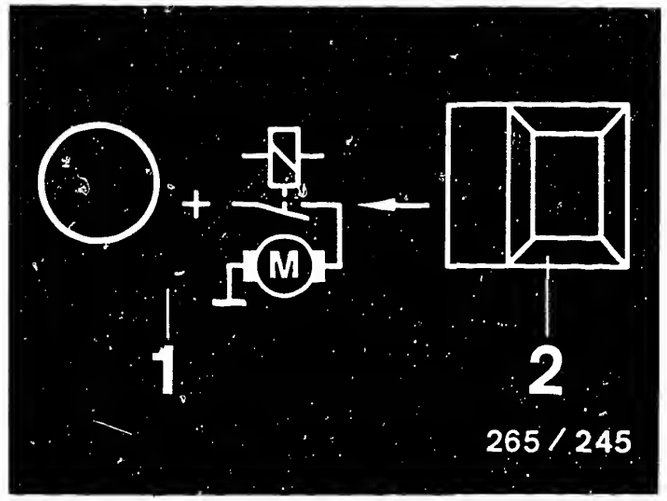
N>

Trouble-shooting:

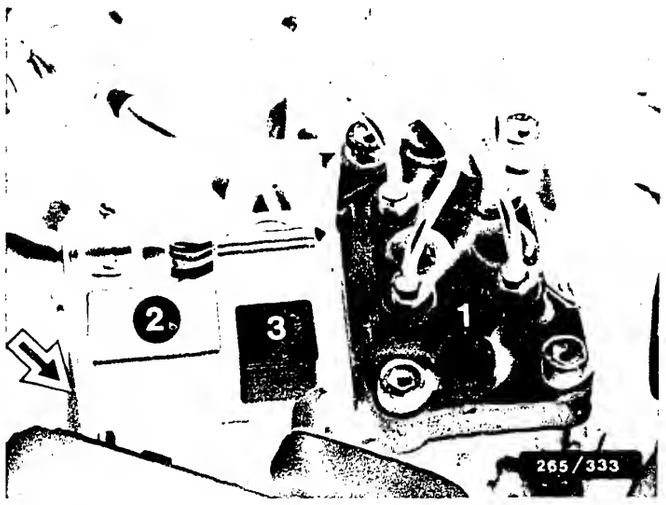
Switch off ignition:

1. LED does not light up or pump motor does not start:

* Motor relay defective (lower illustration).



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor



V

Continued D03

V

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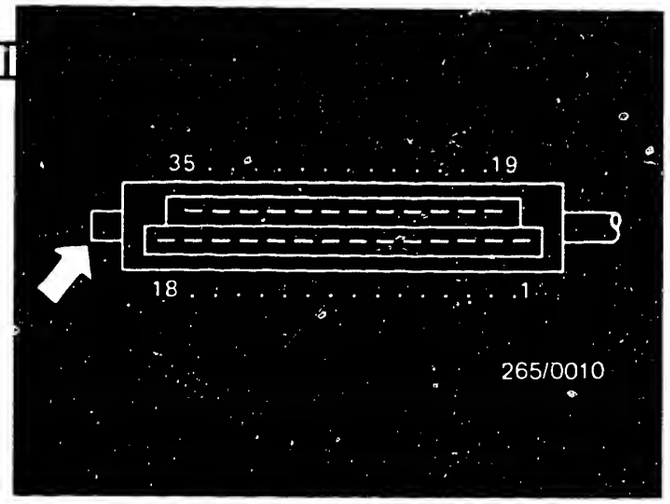
* Check following leads for continuity:

- From controller plug K1/term.14 to plug K3/term.9.
- From K4/term.9 to motor relay term.30.
- From over-voltage protection relay term.30a to plug K3/term.2.
- From plug plate K4/term.2 to motor relay term.86.
- From motor relay term.85 to K4/term.11.
- From K3/term.11 to controller plug K1/term.28.
- From motor relay term.87 to K4/term.13.
- From K3/term.13 to term.B+.



Top view of controller plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding

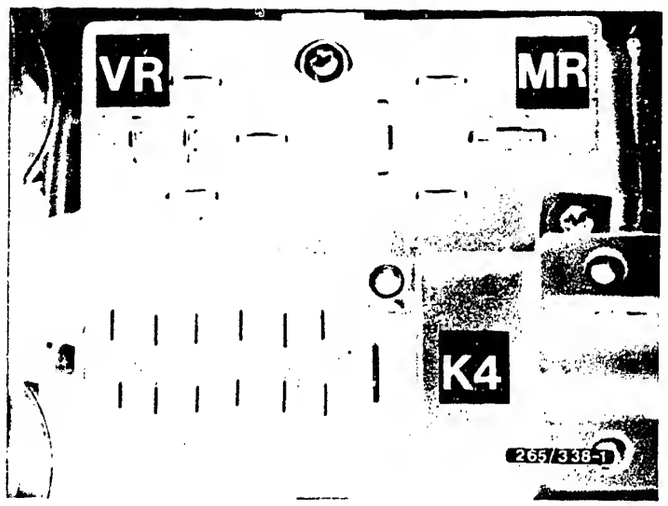
2. Pump motor does not run or LED does not stay lit or very briefly stays lit:

* Check for firm seating of and contact resistance in ground terminal of pump motor.

* Check for firm seating of positive connection of pump motor.
  Check lead from positive connection of pump motor to motor relay term.30.
  Check pump motor for continuity.

* Pump motor defective: exchange hydraulic modulator.

Plug plate of hydraulic mod., position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug



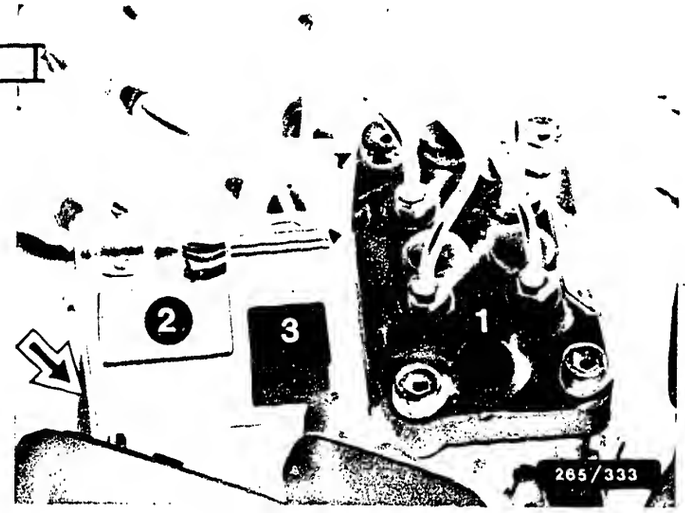
Removing the hydraulic modulator

* For reasons of safety, the hydraulic modulator must not be repaired, but replaced only as a complete unit.

  Excepted are the motor and valve relays.
  Both relays may be replaced.

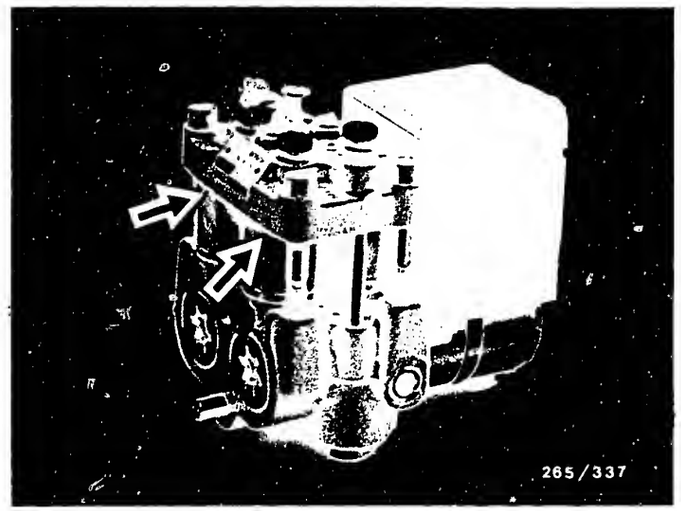
* Excepting brake-line connections, no screws on the hydraulic modulator may be loosened.
  In particular, the hexagon-socket-head cap screws or Torx screws must under no circumstances be loosened.
  After loosening, the brake circuits can never be sealed again.
  D a n g e r t o l i f e !

* Make visual examination for leaks in hydraulic modulator and brake-line connections.
  Pay particular attention to the sealing points indicated by arrows (upper illustration).
  If brake fluid is escaping, tighten (12...16 Nm) or replace the brake-line connections, or replace the hydraulic modulator.



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

Arrows = Sealing points

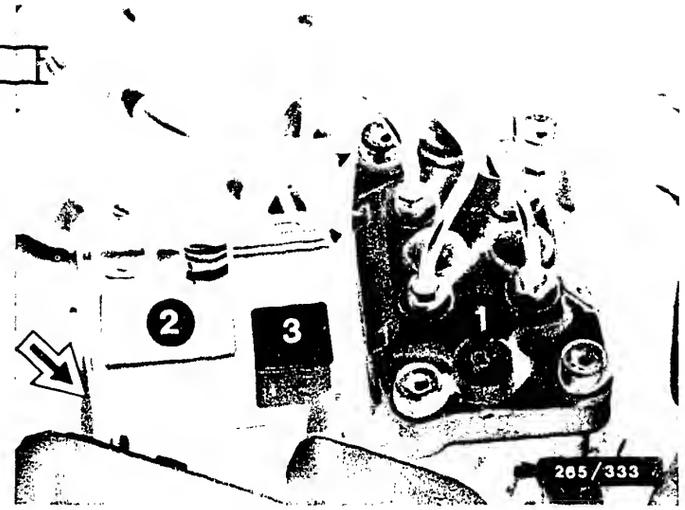


At the base of the hydraulic modulator there is a ventilation bore to the pump plunger.
It is possible that small amounts of brake fluid may escape at this point.
A complaint is justified only if a pool of brake fluid forms beneath the hydraulic modulator when the brake pedal is pressed several times.

* When removing and installing the brake lines, ensure that the lines are marked in accordance with the identification on the hydraulic modulator and are connected again in the appropriate way (e.g. "1" from the hydraulic modulator must be connected to the front left wheel brake cylinder).

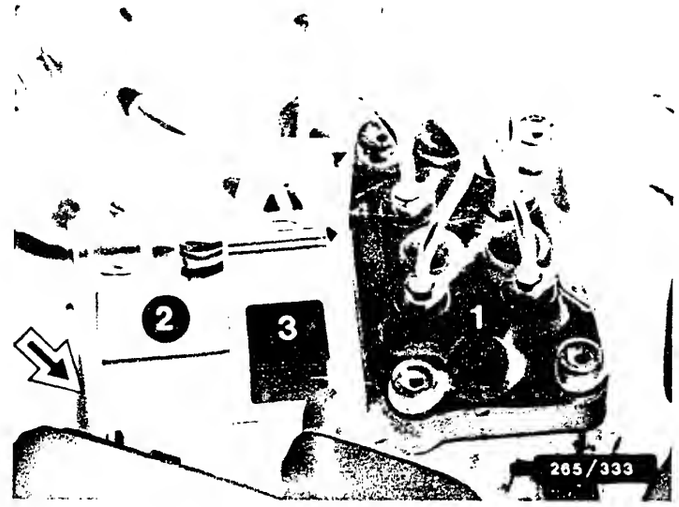
* Identification on hydraulic modulator:

VL = Connection for brake line front left (wheel brake cylinder)
VR = Connection for brake line front right (wheel brake cylinder)
HL = Connection for brake line rear left (wheel brake cylinder)
HR = Connection for brake line rear right (wheel brake cylinder)
V = Front-axle brake circuit from brake master cylinder
H = Rear-axle brake circuit from brake master cylinder



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

* Use only the specified double-head box wrench 9 x 11 mm for loosening and tightening the brake lines.
* Code brake lines and loosen from hydraulic modulator.
* Catch brake fluid and avoid contact with skin, clothing or paintwork!
* Seal brake lines and connections immediately with dummy plugs.
* Disconnect ground cable at pump motor.
* Loosen fastening screw and remove cap.
* Loosen hoop and remove plug.
* Loosen hexagon nuts of bracket and remove hydraulic modulator.



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

Installation

* Position hydraulic modulator into bracket and tighten with the hexagon nuts.
* Connect ground cable to pump motor. Connect 13-pin plug and fasten with the hoop.
* Tighten cap with screw on the hydraulic modulator.
* Connect brake lines to hydraulic modulator according to coding.
* Pay attention to tightening torque for brake-line connections at hydraulic modulator: 12...16 Nm.
* Bleed brake system and check for leaks.
* Thoroughly check ABS with tester.

TEST STEP 5 (TEST SPECIFICATIONS AND NOTES ON OPERATION)

Test step for program-switch position 4 not applicable.

Component/Operation:

Valve relay – Operation (term.27)

* Operation:	Position:
Program switch	5
Push-button	–

* Operation in vehicle:
Ignition on.

* Test specification (indication):
LED 3 (upper ill.) lights up.

N>

Trouble-shooting:

Switch off ignition:

No reading:

* Check for short circuit and contact resistance in following leads:

From K1/term.27 to K3/term.6

From K1/term.32 to K3/term.12

From K4/term.12 to valve relay term.30.

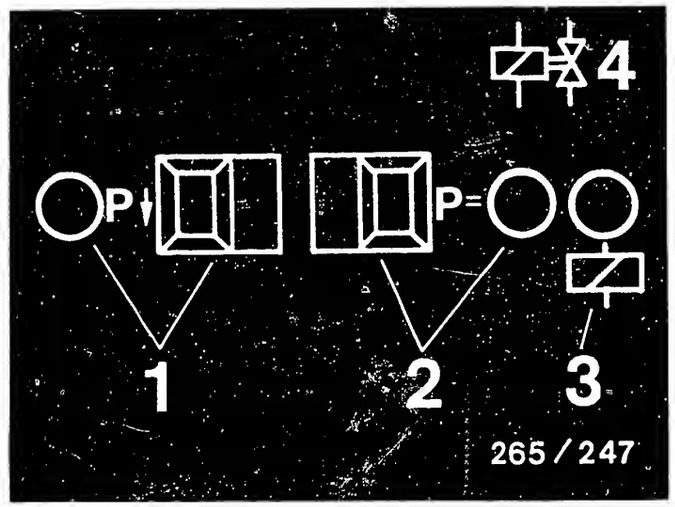
From K4/term.6 to valve relay term.85.

From K4/term.4 to valve relay term.87.

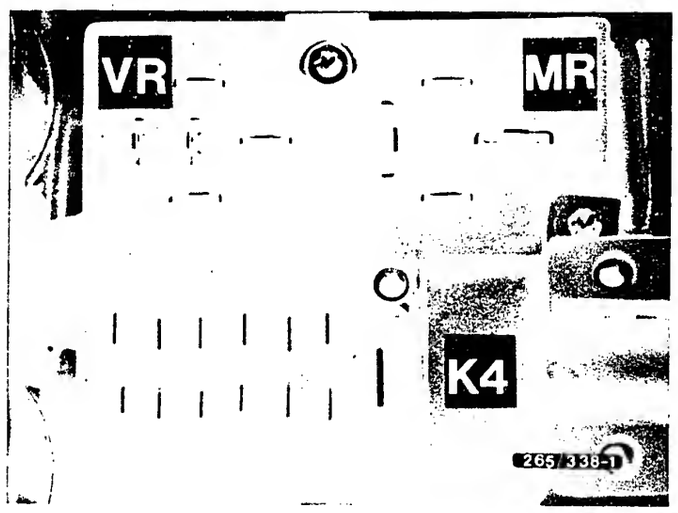
From K3/term.4 to B+.

From valve relay term.86 to motor relay term.86.

* Valve relay defective:
exchange.



Plug plate of hydraulic mod., position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug



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TEST STEP 5 (CONTINUED) (TEST SPECIFICATIONS AND OPERATING INSTRUCTIONS)

Component/function:

Testing operation of the solenoid-operated valves in the hydraulic modulator and correct allocation.

Pressure-holding function points 1 to 3 and pressure-reduction function points 4 to 6.

Note:

Perform test successively for each wheel individually; follow sequence of operations.

* Operation:	Position:
Progr. switch	5

* Trigger function on vehicle and tester:

Jack up vehicle. Must be possible to turn wheel under test easily by hand.
Ignition on.
Set switch 1 (top picture) for wheel selection to the wheel under test. For the rear axle, set to position 4.

Pressure holding
1. (Bottom picture)
Button P = press constantly
Test specification:
LED P = lights up.

N>

1. LED P (bottom picture) does not light up:

* Battery inadequately charged.

* Repeat test with engine running.

* Valve relay (make contact) defective.

* Ground terminals must be bare and connected securely.

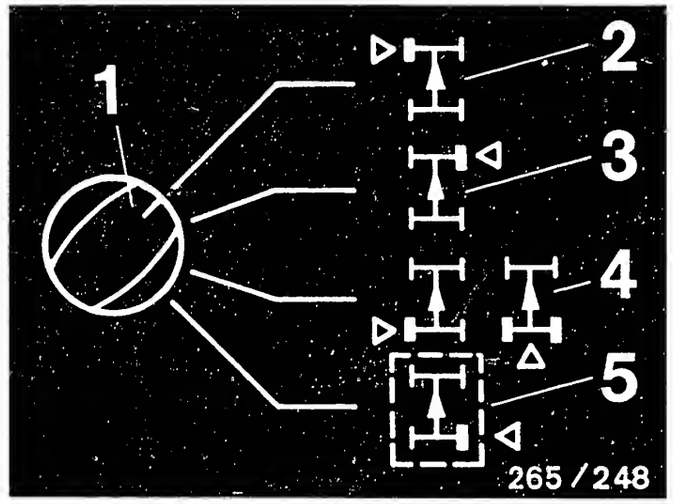
Check the following leads for voltage drop and open circuit.

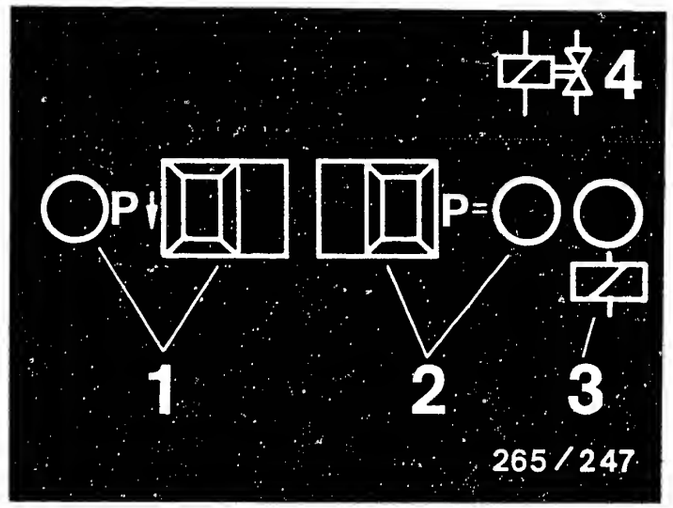
* Ground cable from K1/term. 10 to ground.

* Cable from controller plug K1/term. 34 to ground.

* Positive cable from plug K1/term. 1 to overvoltage-protection relay term. 30a.

Cable from valve relay term. 87 to B+.





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2. Keep brake pedal pressed

Test specification:
Wheel turnable by hand.

3. Push-button P = release (upper illustration)

Test specification:
LED P = goes out, wheel locks.

4. Press push-button P arrow (upper illustration)

Test specification:
LED P arrow lights up. Wheel turnable by hand.

5. Release push-button P arrow (upper illustration)

Test specification:
LED P arrow goes out, wheel locks.

6. Release brake pedal.

N>

2. Locking of wheel or wheel cannot be turned:

* Hydraulic brake lines at hydraulic modulator (lower illustration) mixed up.

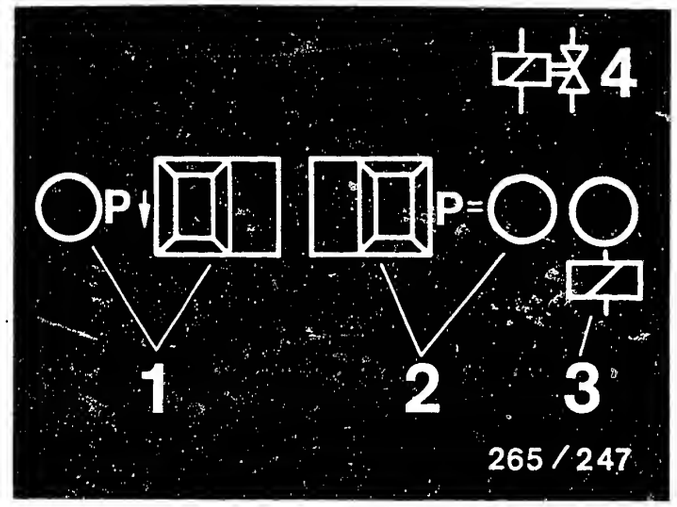
* Solenoid-operated valves correctly electrically connected?

  Wheel, front left:
  from plug K1/term.2
  to K3/term.1.
  Wheel, front right:
  from plug K1/term.35
  to K3/term.3.
  Wheel, rear left:
  from plug K1/term.18
  to K3/term.5.
  Wheel, rear right:
  from plug K1/term.19
  to K3/term.7.

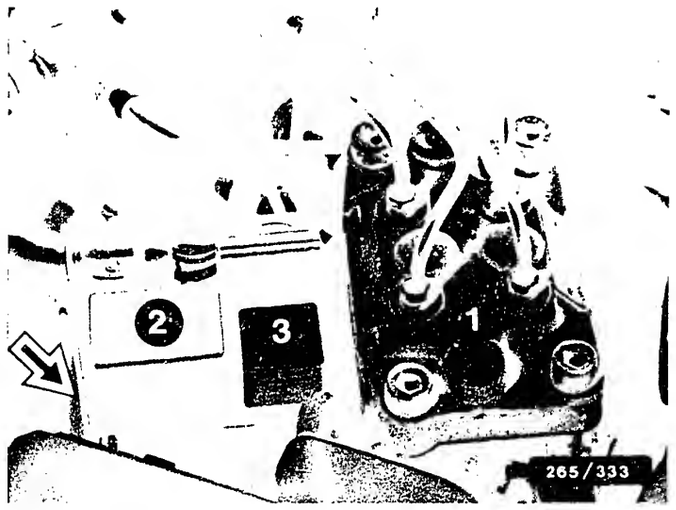
* Check for firm seating of ground strap of pump.
  Contact surfaces for terminals must be bare.

* Check for voltage drop and firm seating of positive connection of pump.
  Connection must be bare and firmly connected.

* Hydraulic modulator defective.



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor



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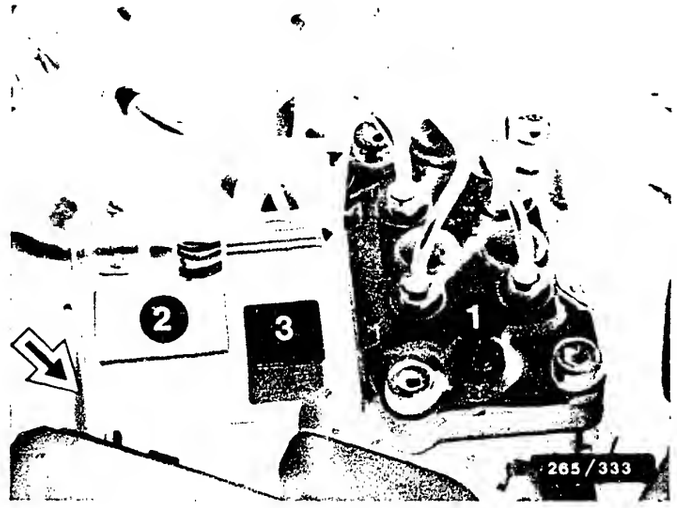
Removing the hydraulic modulator

* For reasons of safety, the hydraulic modulator must not be repaired, but replaced only as a complete unit.

  Excepted are the motor and valve relays.
  Both relays may be replaced.

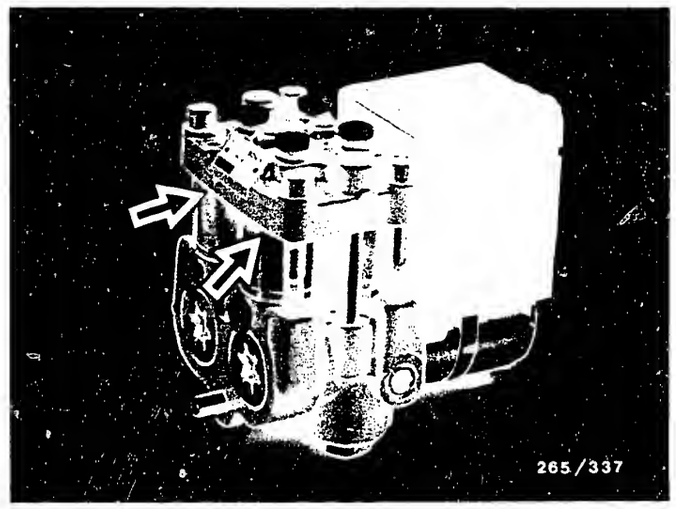
* Excepting brake-line connections, no screws on the hydraulic modulator may be loosened.
  In particular, the hexagon-socket-head cap screws or Torx screws must under no circumstances be loosened.
  After loosening, the brake circuits can never be sealed again.
  D a n g e r t o l i f e !

* Make visual examination for leaks in hydraulic modulator and brake-line connections.
  Pay particular attention to the sealing points indicated by arrows (upper illustration).
  If brake fluid is escaping, tighten (12...16 Nm) or replace the brake-line connections, or replace the hydraulic modulator.



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

Arrows = Sealing points

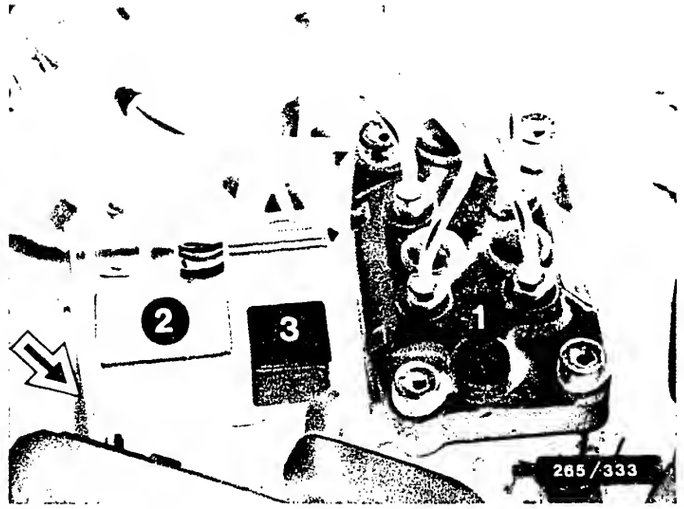


At the base of the hydraulic modulator there is a ventilation bore to the pump plunger.
It is possible that small amounts of brake fluid may escape at this point.
A complaint is justified only if a pool of brake fluid forms beneath the hydraulic modulator when the brake pedal is pressed several times.

* When removing and installing the brake lines, ensure that the lines are marked in accordance with the identification on the hydraulic modulator and are connected again in the appropriate way (e.g. "1" from the hydraulic modulator must be connected to the front left wheel brake cylinder).

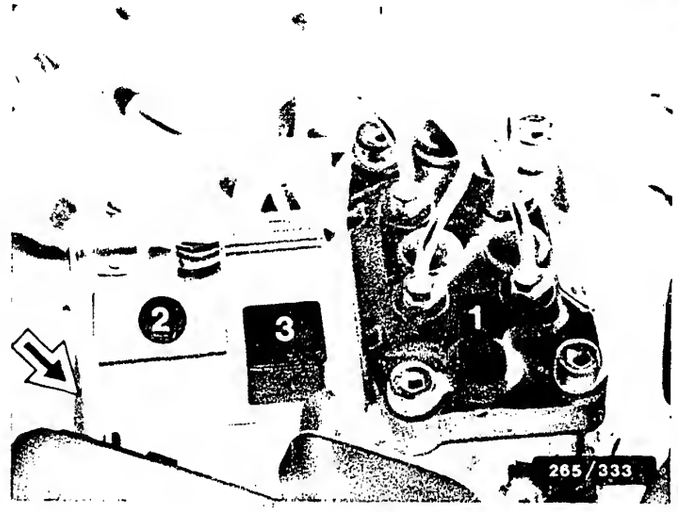
* Identification on hydraulic modulator:

VL = Connection for brake line front left (wheel brake cylinder)
VR = Connection for brake line front right (wheel brake cylinder)
HL = Connection for brake line rear left (wheel brake cylinder)
HR = Connection for brake line rear right (wheel brake cylinder)
V = Front-axle brake circuit from brake master cylinder
H = Rear-axle brake circuit from brake master cylinder



1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay
Arrow = Ground cable, pump motor

* Use only the specified double-head box wrench 9 x 11 mm for loosening and tightening the brake lines.
* Code brake lines and loosen from hydraulic modulator.
* Catch brake fluid and avoid contact with skin, clothing or paintwork!
* Seal brake lines and connections immediately with dummy plugs.
* Disconnect ground cable at pump motor.
* Loosen fastening screw and remove cap.
* Loosen hoop and remove plug.
* Loosen hexagon nuts of bracket and remove hydraulic modulator.



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Ground term., pump motor
5 = Fastening screws

Installation

* Position hydraulic modulator into bracket and tighten with the hexagon nuts.
* Connect ground cable to pump motor. Connect 12-pin plug and fasten with the hoop.
* Tighten cap with screw on the hydraulic modulator.
* Connect brake lines to hydraulic modulator according to coding.
* Pay attention to tightening torque for brake-line connections at hydraulic modulator: 12...16 Nm.
* Bleed brake system and check for leaks.
* Thoroughly check ABS with tester.

TEST STEP 6 (TEST SPECIFICATIONS AND NOTES ON OPERATION)

V

Component/Operation:

Check operation and for mix-up of wheel-speed sensors.

Note:

Check each wheel separately in turn.

* Operation:	Position:
Program switch	6

* Operation in vehicle and at tester:

Chock up vehicle.
Ignition on.
The wheel to be tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked.

Set switch for wheel selection to wheel to be tested (upper illustration).

Turn wheel by hand until LED 2 above the instrument lights up without flickering.
(Wheel speed approx. 1 revolution/ second).

N>

Trouble-shooting:

1. LED (lower illustration) does not light up:

* Wheel speed too low or too high.

* Drive speed of wheel too low or too high.

* Ring gear with incorrect number of teeth or ring gear missing or loose.

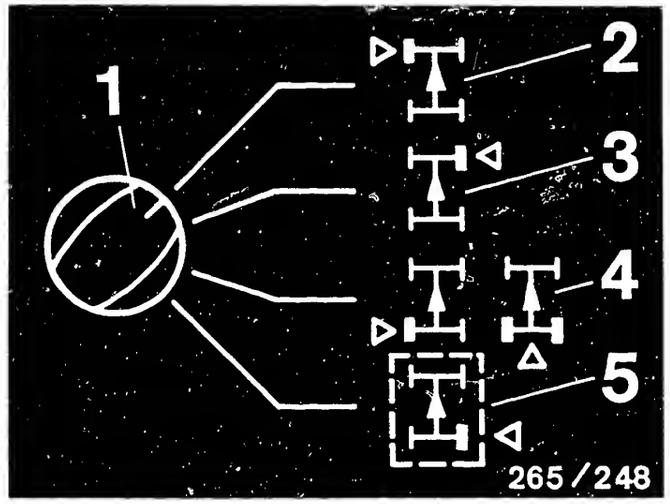
  Number of teeth:
  48 teeth per wheel.

2. Lighting up of LEDs and instrument indicators in incorrect switch position:

* Plug connections of wheel-speed sensors mixed up.

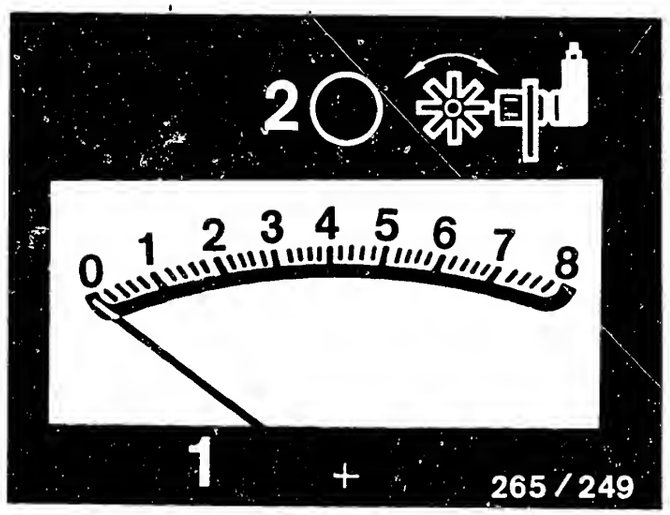
* Leads at plug K1 incorrectly connected:

Check terminal assignment in accordance with terminal diagram.



1 = Wheel-selection switch
2 = Wheel, front left
3 = Wheel, front right
4 = Wheel, rear left or rear axle
5 = Wheel, rear right

1 = Instrument
2 = LED for wheel speed



V

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V

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Then read off reading at instrument.

Test specification (reading).

* Smallest reading = larger 1,6 divisions.

* Permissible fluctuation max. 25 % of greatest reading.

Take for a road test for final check.

Warning lamp must go out with engine running.

Drive at at least 30 km/h. Warning lamp must not light up again.

If no fault can be found with the LED tester, check for loose contacts or rubbed locations in the leads, or exchange controller.

Ignition off.

3. No instrument reading:

* Check wheel-speed sensor for short circuit.
  Disconnect plug connection and measure winding resistance with ohmmeter:

  Test specification: 0,6...1,6k Ω

Check for short circuit in the following wheel-speed sensor leads:

* Wheel, front left:
  from controller plug K1/term.5 and term.4 to plug connection K11.

* Wheel, front right:
  from controller plug K1/term.11 and term.21 to plug connection K13.

* Wheel, rear left:
  from controller plug K1/term.7 and term.9 to plug connection K15.

* Wheel, rear right:
  from controller plug K1/term.24 and term.26 to plug connection K17.

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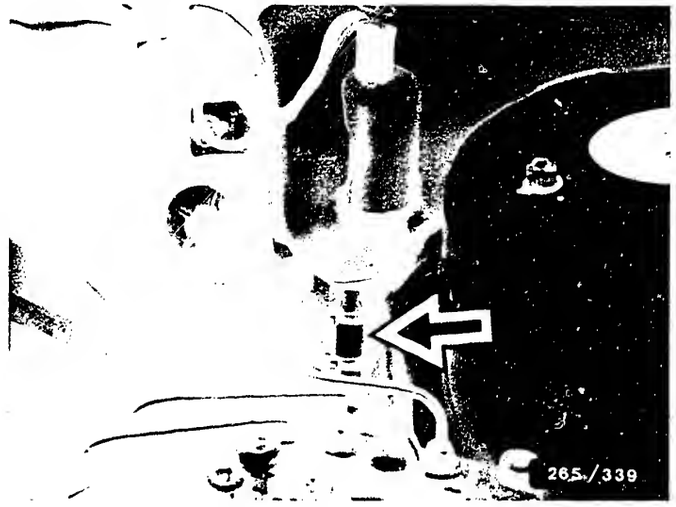
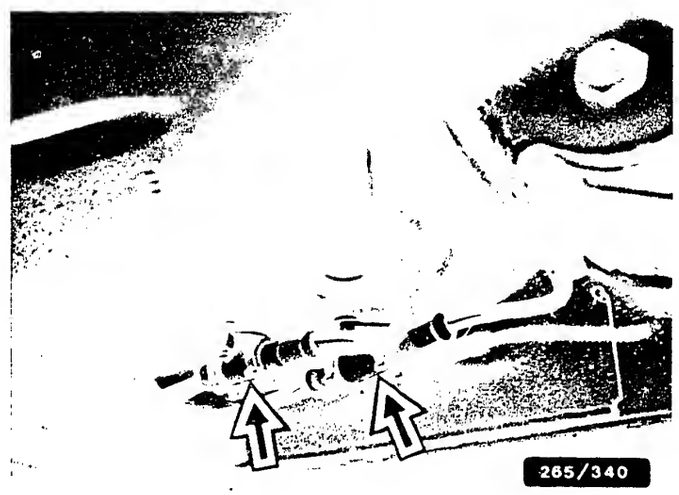


Arrow = Wheel-speed-sensor plug connection, front right

Arrow = Wheel-speed-sensor plug-in connections, rear



4. Instrument reading smaller than 1,6:

* Air gap between wheel-speed sensor and ring gear too wide: nominal dimension 0,2...1,2 mm

* Ring gear defective or loose or with incorrect number of teeth: 48 teeth per wheel.

* Wheel-speed sensor defective: exchange.

5. Fluctuation too great:

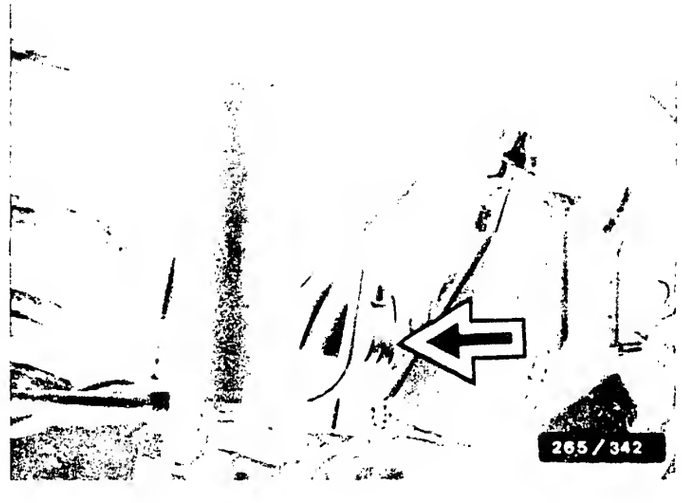
* Wheel-bearing clearance too large.

* Ring gear defective.

* Oval ring gear.

Arrow = Wheel-speed sensor front axle

Arrow = Wheel-speed sensor rear axle



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Removing wheel-speed sensor:

* The plug connections for the front axle are at the respective frame side member and for the rear axle at the vehicle chassis.
* Remove plug connection from bracket and disconnect.
* Loosen fastening screw for wheel-speed sensor and carefully remove wheel-speed sensor.
  Do not use force!

Arrow = Wheel-speed sensor front axle

Installing wheel-speed sensor:

* Check O-ring for cracks and if necessary replace.
* To mount, firstly remove the new wheel-speed sensor from the protective sleeve.
* Lightly grease wheel-speed-sensor housing with the lubricant, Molykote Longterm 2.
* Make sure that there are no metallic foreign bodies at the permanent-magnet edge.
* Push the wheel-speed sensor carefully into the locating bore as far as it will go.
  D o n o t d r i v e i n !
* Use new microencapsulated fastening screws. Tighten fastening screws to at least 8 Nm.
* Re-fasten lead at the specified points.
* Connect wheel-speed sensor to ABS wiring harness and clip plug connection into bracket.
* After repairing, test using LED tester.

Arrow = Wheel-speed sensor rear axle

T E C H N I C A L B U L L E T I N

13....39
VDT-I-265/102 En
1.1986

REPAIR PROHIBITION /
MAXIMUM ALLOWABLE STORAGE TIME
FOR ABS HYDRAULIC MODULATORS

Replaces edition of 7.1984

1. Repair prohibition

ABS for passenger vehicles is a safety system.
Unauthorized tampering with ABS components brings with it the danger of impairment of the proper functioning of the ABS system.

For reasons of safety, therefore, the
hydraulic modulator may under no circum-
stances be repaired, but instead must be
exchanged as a complete unit.

Only the engine and valve relays may be exchanged.
No other screws or plugs may be loosened or removed.

2. Maximum allowable storage time

The maximum allowable storage time for hydraulic modulators is 5 years from the date of manufacture (FD) specified on the product.

This requires that the following storage conditions be fulfilled:
- Hydraulic modulator filled with brake fluid (supplied in filled condition).
- Vertical/upright position (hood on top).
- Ambient temperature between -20°C and +50°C.
- Dry storage.

After 5 years storage time, all rubber and plastic parts must be replaced and the hydraulic modulator must be subjected to a functional test.

The replacement of rubber and plastic parts and the functional test can be carried out only at the place of manufacture. After testing, the hydraulic modulators are marked with |L| and a new date of manufacture (FD).

Service workshops in the Federal Republic of Germany should send the hydraulic modulators to:
Robert Bosch GmbH Abt. K1/VAK 2,
Robert-Bosch-Straße, 7141 Schwieberdingen.
Service workshops in other countries are requested to send the hydraulic modulators to:
Robert Bosch GmbH, KH/LAV 2 - Auspackraum,
z.H. an K1/VAK 2, Auf der Breit 4,
D-7500 Karlsruhe 41
West Germany.

The hydraulic modulators should be sent to us pre-paid.
Please refer to this Technical Bulletin on the enclosed delivery ticket.
A fee is charged for parts replacement and functional testing.

Responsible:
ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)
Please address questions and comments concerning the contents to our authorized representative in your country.

For production reasons:
continued on the following coordinate.

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